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VARIETAL COMPOSITION OF CANADIAN HARD RED SPRING WHEAT

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The Cereal Division has been determining the varietal composition of samples of Manitoba 1, 2 and 3 Northern Official Standards since 1926 and of samples taken from cargo shipments since 1928. The main purpose of these studies was to obtain some idea as to the part which varieties play in the hard red spring wheat appearing in the trade.

Red Fife, the leading variety grown in the Great Plains area of the Canadian West in the early days, was late in maturity and frequently was damaged by early fall frosts. Many varieties such as Preston, Percy, Stanley, Ladoga and Huron were introduced in an effort to meet the demand for earlier maturing varieties of high quality but none of these was entirely satisfactory. The introduction of Marquis in 1910 however, marked a real step forward and provided not only an earlier wheat than any of the above varieties but also retained the world wide reputation for quality set by Red Fife.

As the wheat growing area extended further northward a demand was created for still earlier ripening varieties. For a time, around 1918-1920, Ruby was grown to some extent but it was soon recognized that a more suitable variety than any then existing was needed. In attempting to meet this demand, Garnet, a high yielding variety ripening 7 to 10 days earlier than Marquis was introduced in 1926, while Reward, a very high quality wheat maturing from 6 to 8 days earlier than Marquis was made available two years later.

Due to the fear of black stem rust varietal changes have been taking place in the older wheat growing areas of southern Manitoba and south-eastern Saskatchewan during the past 15 years. Durum varieties gradually have been gaining ground while such new varieties as Ceres and Reward have largely come to replace Marquis.

In districts further West other new varieties such as Red Bobs have become established and are coming to be grown fairly extensively.

Since it will be shown later that Garnet has become an important variety in the trade, it might be noted here that this variety was not eligible to grade higher than Manitoba 2 Northern prior to 1935. Beginning with the 1935–36 crop year Garnet has been withdrawn from the Manitoba 2 Northern grade and two separate grades have been established, namely, 1 C.W. Garnet and 2 C.W. Garnet. Where wheat of this variety is not eligible for either of these grades, it will be graded Manitoba 3 Northern or lower. This paper deals with the Garnet variety on the basis of grading before the crop of 1935–36.

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METHODS AND MATERIALS

Sources of Material.

Varietal analysis was made on samples derived from four main sources, namely,—

(1) The official Standards of the Western Grain Inspection Division, Winnipeg, for the years 1926 and 1929 inclusive.

(2) The official Export Standards of the Western Grain Inspection Division, Winnipeg, for the years 1930 to 1934 inclusive.

(3) Official samples of Manitoba 1, 2 and 3 Northern representing cargo shipments leaving Fort William, Ont., and Vancouver, B.C.

(4) Samples representing exported cargoes of wheat obtained through the Corn Exchange, Liverpool, England, and from the Scottish Wholesale Co-operative Society, Glasgow.

The Official Standards made up early in October at the beginning of each crop year by the Chief Grain Inspector for the Standards Board of the Board of Grain Commissioners represent the minimum quality of the grade and are used as the basis for grading the incoming wheat. Varietal analysis of these grades would represent chiefly the wheat coming from those districts where harvesting and threshing operations begin early in the crop year.

The Export Standard samples are composites made up to represent 25% of the Official Standards and 75% of the general Winnipeg average of each grade. These are used as a basis for grading export shipments of the crop but like the Official Standards would mostly contain wheat from the earlier harvests.

Varietal Composition of Samples

The varietal composition was determined by growing tests. An aliquot sufficient to seed one rod-row plot was taken from each sample, except in the case of the official standards and export standards where enough seed to sow twenty rod-rows was used. Each rod-row provided from 250 to 325 plants. These plants when fully headed were carefully harvested and identified by trained men who classified the different varieties and from the tabulations thus provided, the varietal composition was calculated.

Classification of Varieties

The varieties found in this survey are listed below, and for convenience in classifying the composition of each sample, they are arranged into five groups.

1. Marquis.
2. Garnet
3. Reward
4. Other bread wheat varieties classed as "Good"—Red Fife, Ruby, Renfrew, Supreme, Early Triumph, Kitchener, Ceres, Pioneer, Early Red Fife, Type IC, Red Bobs 222.
5. Other bread wheat varieties classed as "fair to poor"—Huron, Preston, Stanley, Parkers Selection, Fishers Selection, Quality, (white wheat), Axminster (white wheat), Prelude, Riga, Ladoga, Federation, White Russian, Miscellaneous, Speltoids, etc.

The milling qualities of Marquis, Garnet and Reward may be referred to briefly as follows:

Marquis—This variety is the standard of quality for bread wheat varieties and may be described as possessing excellent milling and baking qualities.

Garnet—Possessing different characteristics to Marquis, being more vitreous in kernel character, lower in baking strength and producing more creamy or yellow flour colour.

Reward—Noted for its excellent berry, relatively high protein content, and excellent baking strength and flour colour.

The fourth group represents varieties which compare favourably with Marquis in essential milling and baking qualities.

"Fair to poor" bread wheat varieties are those which are considered inferior to Marquis in one or more important quality characteristics.

The above quality descriptions are based upon results from careful experimental milling and baking tests conducted in the laboratories of the Cereal Division over a period of years and from other published data (*1*).

VARIETAL COMPOSITION OF SAMPLES COLLECTED

1. Official Standards and Export Standards

It was noted above that varietal analysis was made on the Standards from 1926 to 1929 inclusive and on the Export Standards from 1930 to 1934 inclusive. As all these samples were made up at the same time each year, it was not thought necessary to separate the data procured. In Table 1 the percentages for the five groups of wheat varieties determined for Manitoba 1 Northern are presented.

TABLE 1.—MANITOBA 1 NORTHERN—VARIETAL COMPOSITION FOR STANDARDS (1926–1929) AND FOR EXPORT STANDARDS (1930–1934)

Varietal groups	1926	1927	1928	1929	1930	1931	1932	1933	1934
	%	%	%	%	%	%	%	%	%
Marquis	66.0	77.1	53.6	61.4	76.8	58.5	69.5	82.4	84.6
Garnet			.27	.36	3.3	8.4	.6	1.3	.2
Reward					2.0	4.2	7.2	2.5	2.3
"Good" milling wheats	20.6	11.7	41.5	36.2	15.0	23.8	20.5	10.1	12.1
"Fair to poor" milling wheats	13.4	11.2	4.6	2.0	2.9	5.0	1.9	3.6	.7

From the above it will be seen that Marquis predominates while those grouped as "good" milling wheats occupy second place. It will be noted also that the "fair to poor" milling wheat group has tended to decrease each year. As the Garnet variety is excluded from No. 1 Northern grade it was found only in small percentages.

In Tables 2 and 3, it will be observed that Marquis was the chief variety represented in both the Manitoba 2 and 3 Northern grades. After 1928 Garnet appeared in increasing percentages and the "fair to poor" milling group gradually decreased to less than 1.5%. Reward although distributed in 1928 just two years after Garnet has not shown the same

increase in the percentage composition of these two grades. Other wheats comprising the "good" milling group were found in substantial percentages in all years. It should not, however, be expected that large percentages of Garnet or Reward would appear in these Standard and Export Standard samples. Their chief virtue lies in their early ripening character and it would, therefore, be expected that they would be grown chiefly in the northern areas from which the wheat crop would not likely have been marketed before the standard samples had been made up.

TABLE 2.—MANITOBA 2 NORTHERN—VARIETAL COMPOSITION FOR STANDARDS (1926–1929) AND EXPORT STANDARDS (1930–1934)

Varietal groups	1926	1927	1928	1929	1930	1931	1932	1933	1934
	%	%	%	%	%	%	%	%	%
Marquis	72.02	68.72	59.69	44.39	66.97	53.14	58.89	50.74	53.25
Garnet	—	—	3.78	14.24	15.01	20.89	14.96	21.73	26.41
Reward	—	—	—	—	.85	.34	2.69	5.89	2.21
"Good" milling wheats	8.59	16.67	30.62	35.31	12.66	20.12	21.72	18.85	17.37
"Fair to poor" milling wheats	19.32	14.63	5.86	6.05	4.51	5.44	.85	2.74	1.44

TABLE 3.—MANITOBA 3 NORTHERN—VARIETAL COMPOSITION FOR STANDARDS (1926–1929) AND EXPORT STANDARDS (1930–1934)

Varietal groups	1926	1927	1928	1929	1930	1931	1932	1933	1934
	%	%	%	%	%	%	%	%	%
Marquis	62.75	53.65	52.70	43.47	52.47	61.91	61.42	66.99	54.34
Garnet	—	1.52	2.52	14.84	11.93	7.66	12.44	19.55	15.64
Reward	—	—	—	—	.27	3.50	2.53	2.43	6.46
"Good" milling wheats	20.09	32.59	38.55	30.57	28.01	22.51	18.98	8.39	22.49
"Fair to poor" milling wheats	17.10	12.16	6.20	9.11	11.32	4.42	4.53	2.49	1.07

2. Varietal Composition of Atlantic and Pacific Cargo Samples

In Table 4, the data presented for 1928 and 1929 were obtained from samples secured from the Liverpool Corn Exchange and from the Scottish Wholesale Co-operative Society. The data for later years were supplemented very largely from samples supplied by the office of the Chief Grain Inspector, from shipments designated ex Atlantic and ex Pacific.

It will be noted that Marquis has been the predominant variety in the Manitoba 1 Northern grade, but to a less extent in the Pacific shipments than in the Atlantic shipments. It is quite clear that Garnet has not appeared to any appreciable extent and credit is due the Inspection Division in being able to identify the grain of this variety to such a remarkable degree that its percentage has not averaged over 4% in any one year and only in a few cases has it risen as high as 6% in the composition of any sample in this grade. Reward, Red Bobs and other good milling wheat varieties were found in substantial percentages.

In the Manitoba 2 Northern grades, the percentage of Marquis has decreased since 1928 and since that date it is quite apparent that Garnet

TABLE 4.—VARIETAL COMPOSITION OF OFFICIAL SAMPLES COLLECTED FROM VARIOUS SOURCES REPRESENTING CARGO SHIPMENTS

—	1928	1929	1930 Atlantic	1930 Pacific	1931 Atlantic	1931 Pacific	1932 Atlantic	1932 Pacific	1933 Atlantic	1933 Pacific	1934 Atlantic	1934 Pacific
	Manitoba 1 Northern											
No. cargoes	1	8	20	24	72	56	80	78	88	74	94	50
Marquis %	67.0	79.3	75.7	62.1	65.5	51.0	66.0	52.9	70.1	55.1	63.7	48.7
Garnet %	0.0	2.1	1.1	3.6	3.2	4.0	2.3	3.9	2.5	2.8	2.7	3.0
Reward %	0.0	—	.6	.7	5.0	6.7	8.4	9.2	9.1	10.9	8.9	10.2
"Good" wheats %	15.8	11.2	19.6	29.7	23.7	34.1	19.9	31.9	17.0	25.5	20.7	35.9
"Fair to poor" wheats %	17.0	5.3	2.0	3.6	2.4	3.9	3.2	1.8	1.3	1.4	3.7	1.9
	Manitoba 2 Northern											
No. cargoes	2	29	3	3	65	65	79	59	52	50	50	50
Marquis %	64.0	51.7	42.8	25.2	39.9	11.8	40.2	15.6	44.7	12.6	40.0	9.2
Garnet %	3.3	26.4	33.2	53.6	34.6	62.7	34.4	65.3	33.4	66.8	37.6	74.1
Reward %	0.0	0.1	1.5	.7	3.7	2.5	6.0	4.8	7.6	6.3	6.6	4.1
"Good" wheats %	23.2	13.6	17.1	18.2	18.6	19.0	15.5	11.9	11.8	11.8	12.6	10.3
"Fair to poor" wheats %	7.3	6.5	5.0	1.9	2.6	2.9	2.5	1.7	1.5	1.5	3.1	1.3
	Manitoba 3 Northern											
No. Cagroes	2	–	2	–	35	36	56	54	51	50	50	50
Marquis %	51.3	–	56.5	–	39.1	32.8	41.7	27.6	51.4	17.8	33.9	14.9
Garnet %	1.6	–	11.1	–	24.8	30.1	27.4	43.6	22.4	53.4	38.9	57.6
Reward %	0.0	–	0.0	–	3.5	2.3	8.1	5.9	6.8	8.9	8.7	7.5
"Good" wheats %	28.1	–	26.2	–	25.0	28.3	19.0	20.7	17.0	17.0	13.8	17.3
"Fair to poor" wheats %	15.7	–	5.7	–	6.7	5.5	2.4	1.4	1.4	1.7	3.5	2.4

TABLE 5.—OFFICIAL SAMPLES COLLECTED FROM OUTGOING CARGOES BY THE OFFICE OF THE CHIEF GRAIN INSPECTOR, WINNIPEG, MANITOBA

—		Manitoba 1 Northern							
		1931		1932		1933		1934	
		Atlantic	Pacific	Atlantic	Pacific	Atlantic	Pacific	Atlantic	Pacific
No. of cargoes		30	30	50	50	50	50	50	50
Bushels represented		1,331,992	1,004,716	4,849,000	2,623,000	4,630,666	2,100,782	6,045,000	1,706,000
Marquis	%	69.8	49.7	66.5	51.5	68.3	53.7	61.9	53.7
Garnet	%	2.4	3.8	1.6	4.2	2.9	2.8	2.4	2.7
Reward	%	6.7	4.3	8.5	9.5	10.3	10.7	8.1	6.0
"Good" wheats	%	10.5	37.1	19.6	32.7	16.0	31.0	23.7	34.6
"Fair to poor" wheats	%	1.4	4.8	2.3	1.7	2.2	1.4	3.2	2.4
		Manitoba 2 Northern							
No. of cargoes		31	29	50	50	50	50	50	50
Bushels represented		1,917,734	1,888,350	2,932,000	2,915,000	3,446,073	2,057,822	5,582,000	2,282,000
Marquis	%	40.9	6.8	41.1	16.1	44.6	12.6	40.0	9.2
Garnet	%	33.5	65.3	33.0	64.8	33.4	66.8	37.6	74.1
Reward	%	4.0	2.1	6.3	5.0	7.7	6.3	6.6	4.1
"Good" wheats	%	18.0	21.6	15.9	11.7	11.8	11.8	12.6	10.3
"Fair to poor" wheats	%	3.3	3.9	3.5	2.1	2.2	2.3	3.2	1.3
		Manitoba 3 Northern							
No. of cargoes		31	30	50	50	50	50	50	50
Bushels represented		1,670,869	1,709,947	833,000	1,788,000	1,225,167	1,757,766	3,184,000	1,549,000
Marquis	%	38.8	33.0	42.3	27.6	51.3	17.8	33.9	14.9
Garnet	%	25.0	30.0	27.0	43.5	22.5	53.4	38.9	57.6
Reward	%	3.5	2.4	8.6	5.9	6.7	8.9	8.7	7.5
"Good" wheats	%	24.9	28.0	18.6	20.8	16.9	16.8	13.8	17.3
"Fair to poor" wheats	%	7.5	6.3	3.3	1.9	2.0	2.1	3.5	2.4

TABLE 6.—TOTAL NUMBER OF BUSHELS OF MANITOBA 1, 2, AND 3 NORTHERN WHEAT EXPORTED FROM ATLANTIC AND PACIFIC PORTS FOR CROP YEARS 1932–1933–1934

—	1932 Atlantic	1932 Pacific	1933 Atlantic	1933 Pacific	1934 Atlantic	1934 Pacific
	Manitoba 1 Northern					
No. of bushels exported	49,381,742	15,602,508	80,664,469	18,236,758	7,377,706	16,087,231
No. of bushels represented by samples	4,849,000	2,603,000	4,630,666	2,100,782	6,045,000	1,706,000
Per cent of total wheat exported represented by samples	9.82	16.68	5.74	11.51	8.19	10.60
	Manitoba 2 Northern					
No. of bushels exported	69,075,107	46,197,126	42,608,310	22,263,061	29,928,941	14,342,592
No. of bushels represented by samples	2,932,000	2,915,000	3,446,073	2,057,822	5,582,000	2,282,000
Per cent of total wheat exported represented by samples	4.24	6.30	8.08	9.24	10.86	15.91
	Manitoba 3 Northern					
No. of bushels exported	15,030,694	13,191,563	4,162,906	5,336,348	7,751,887	3,859,410
No. of bushels represented by samples	833,000	1,788,000	1,225,167	1,757,766	3,184,000	1,549,000
Per cent of total wheat exported represented by samples	5.54	13.56	29.43	32.93	41.07	40.13

has been a big factor in making up the composition of the samples within this grade. This is especially true of the ex Pacific samples where Garnet has been the predominant variety from 1930 to 1934.

A similar picture is presented for the Manitoba 3 Northern grades as that for the Manitoba 2 Northern except that Garnet does not average as high in the former. Somewhat higher percentages are shown for the varieties comprising the "good" wheat group.

Reviewing the varietal analysis for the cargo samples of the three grades, it would seem that Marquis was becoming less prominent in our export wheat, being replaced to a considerable extent by Garnet, Reward and varieties classed as "good" milling wheats. The varieties of the "fair to poor" group have decreased to almost negligible percentages.

In Figure 1, the percentages of Marquis, Garnet and Reward found in the export shipments for the years 1930 to 1934 are graphically illustrated. The uniformity in the Manitoba 1 Northern grade is very well maintained in both the Atlantic and Pacific cargoes. For the Manitoba 2 and 3 Northern, the higher percentages of Garnet and the lower percentages of Marquis appearing in these grades in contrast to the Manitoba 1 Northern are quite evident. While Reward is constantly increasing in popularity, the percentages appearing in the shipments are not high.

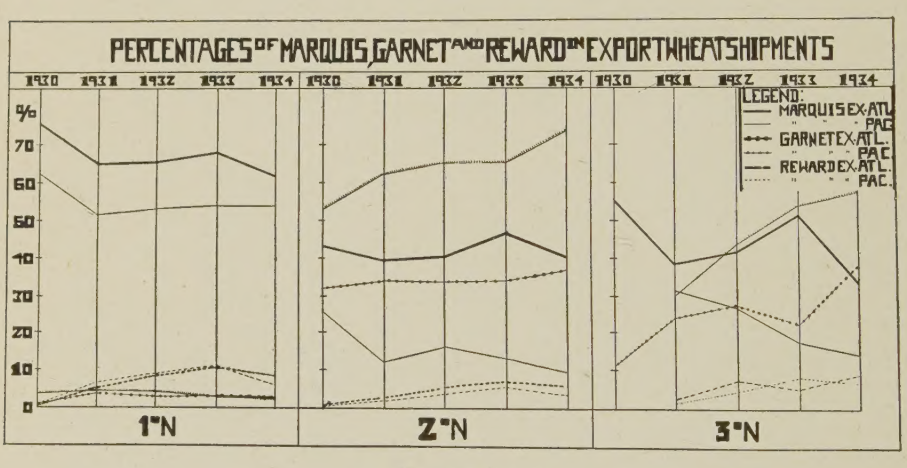

FIGURE 1

In Table 5 the analysis of the official samples collected by the office of the Chief Grain Inspector is given. While these data were for the most part included in Table 4 they are of sufficient interest to segregate into a separate table. Inasmuch as the samples for both the Atlantic and Pacific cargoes each year are approximately the same in number and have been collected over a similar number of months, a more accurate record of the varieties composing the cargoes leaving the two ports is thereby provided. In addition, the number of bushels of wheat represented in these shipments is worthy of consideration. As was the case in Table 4 it will be observed that Marquis is found to a greater extent in the Atlantic shipments than in the Pacific and that the varieties of the "good" group together with Garnet and Reward are contributing substantially to the varietal content of these export shipments.

Table 6 gives the actual number of bushels of each grade of Manitoba 1, 2 and 3 Northern exported from the Atlantic and Pacific ports for the crop years 1932–1934 inclusive as well as the number of bushels of grain represented by the varietal analysis in Table 5. It will be seen that the varietal analysis has been determined from a fairly representative number of the total bushels of wheat exported.

VARIETAL PERCENTAGES AND PROTEIN CONTENT IN CARGO SHIPMENTS FOR YEARS 1932, 1933 AND 1934

In addition to obtaining the varietal composition for the 1932, 1933, and 1934 samples, the protein content was also determined. The maximum, minimum and average protein, together with the standard deviations are given in Table 7. It will be observed that there is little uniformity in the protein percentages for the samples for any grade.

TABLE 7.—COMPARISON OF PROTEIN CONTENT IN ATLANTIC AND PACIFIC SHIPMENTS FOR YEARS 1932–1934 INCLUSIVE

Percentage of Protein found in Chief Grain Inspectors samples for years 1932 to 1934.

*ATLANTIC CARGOES

Grade	1°			2°			3°		
	1932	1933	1934	1932	1933	1934	1932	1933	1934
Maximum %	14.7	15.5	15.1	14.23	15.72	16.2	15.4	15.2	16.3
Minimum %	12.21	13.0	12.2	11.93	10.46	11.8	11.7	11.2	11.8
Average %	13.81	13.80	13.88	12.90	14.04	13.19	13.50	13.57	12.87
Standard deviation	.143	.399	.656	.514	1.001	1.24	.79	.931	.705

*PACIFIC CARGOES

Grade	1°			2°			3°		
	1932	1933	1934	1932	1933	1934	1932	1933	1934
Maximum %	15.5	14.7	14.6	13.36	13.05	12.9	17.1	13.4	13.9
Minimum %	12.7	12.9	13.3	10.19	11.15	10.8	11.4	11.0	10.3
Average %	13.76	13.71	13.94	12.16	12.01	12.33	12.56	11.99	12.02
Standard deviation	.478	.372	.118	.802	.491	.474	.815	.633	.706

* There are 50 cargoes in each grade for each year for both Atlantic and Pacific cargoes making 900 samples in all.

It will be noted from the standard deviations however that Manitoba 1 Northern *fluctuates less than the other two grades and would therefore be a more reliable wheat from this standpoint.* This is true, not only for the Atlantic but, for the Pacific shipments as well. The Pacific shipments of the Manitoba 2 and 3 northern grades average in all years, *lower protein* than the Atlantic shipments, but the Atlantic shipments of the 2 Northern grade are in 1933 and 1934 much more variable in this respect than the Pacific shipments.

In Figures 2, 3 and 4, the percentage composition of Marquis, Garnet and Reward for each Manitoba 2 Northern cargo sample together with its protein content are shown graphically. The percentage composition

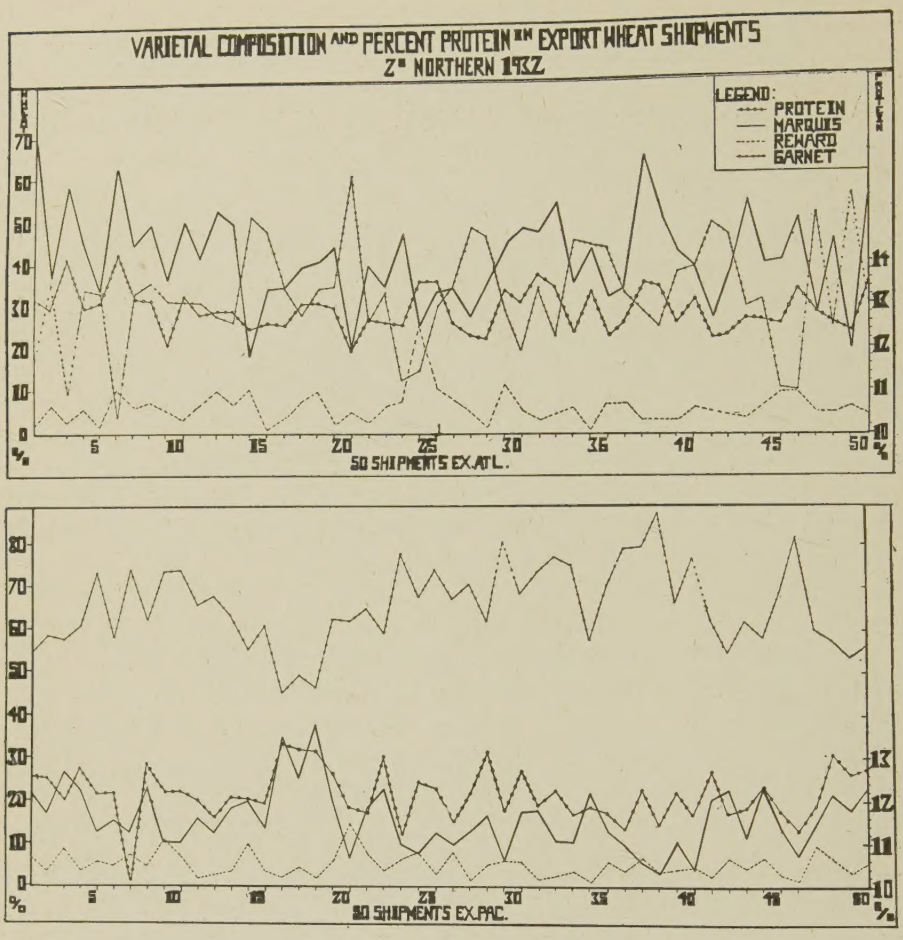

FIGURE 2

for the remaining varieties, chiefly comprising the "good" group can be obtained from Table 5. It is quite evident that 2 Northern ex Atlantic is much more variable in both varietal composition and in protein content than 2 Northern ex Pacific for 1933 and 1934 and less variable in protein content for 1932. In all three years, Garnet is the predominant variety in the Pacific samples, while there are wide fluctuations in the Garnet composition of the Atlantic samples.

Simple correlation and regression coefficients for the percentage composition of Marquis, Garnet and Reward of the Manitoba 2 Northern samples and their protein content are given in Table 8. It will be noted that the percentages of Marquis in the ex Atlantic samples of 1932 and 1934 are positively correlated with their protein content and that the percentages of Garnet are negatively correlated. In 1933 no significant correlation was found for variety composition and protein content. For the 2 Northern ex Pacific samples the percentages of Marquis and protein content were correlated for the 1932 and 1933 samples but showed little relationship for the 1934 samples. In the 1932 samples the Garnet per-

centages were negatively correlated with protein but in the other two years there was little relationship.

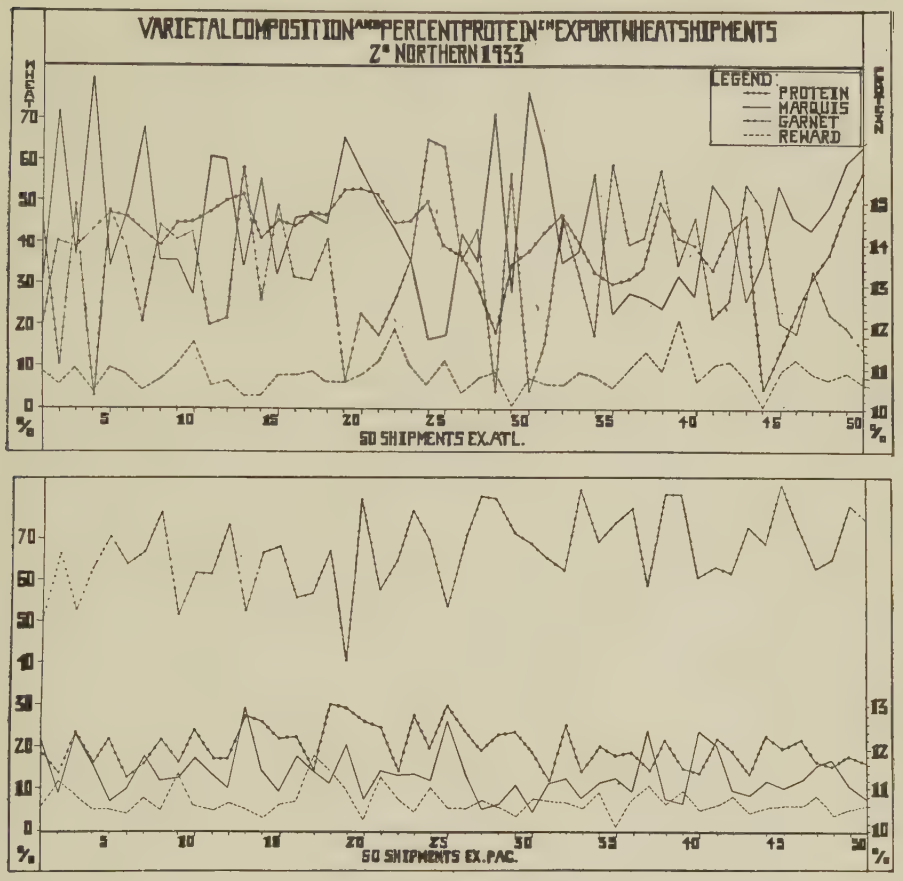

FIGURE 3

TABLE 8.—SIMPLE CORRELATION AND REGRESSION COEFFICIENTS FOR VARIETAL COMPOSITION AND PER CENT PROTEIN IN CARGOES OF 2° WHEAT FOR CROP YEARS 1932–33–34

Year	No. of cargoes	Variety	2° ex Atlantic		2° ex Pacific	
			Coefficient of		Coefficient of	
			Correlation	Regression	Correlation	Regression
1932	50	Marquis	*+.6543	+.0233±.0045%	*+.6105	+.0509±.0093%
		Garnet	*−.6353	−.0251±.0043%	*−.6059	−.0387±.0071%
		Reward	+.1589		−.1479	
1933	50	Marquis	+.0833		*+.3446	+.0295±.0049%
		Garnet	−.0062		−.1503	
		Reward	+.0929		−.1223	
1934	50	Marquis	*+.8831	+.0507±.0038%	+.0183	
		Garnet	*−.8610	−.0462±.0039%	−.1442	
		Reward	*−.5913	−.2305±.0444%	−.1538	

* Indicates P. Value of less than 0.01.

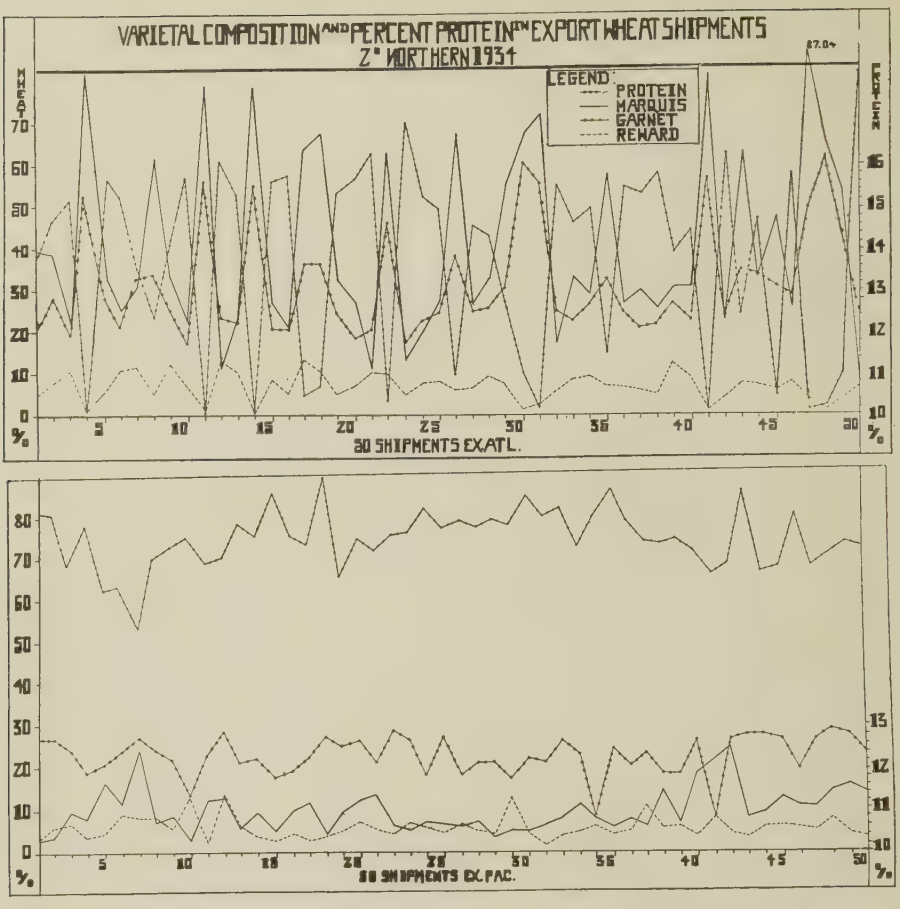

FIGURE 4

The regression coefficients indicate the extent to which an increase or decrease of 1% of the particular variety would have affected the protein content. In the case of the 1932 ex Atlantic samples, for instance, for every increase of 1% of Marquis there would likely have been an increase of 0.0233% of protein. In other words if the 50 cargoes had been 100% Marquis instead of 66.5% the average protein content would, by calculation have increased 0.78%. Reasoning from this it would follow that the presence of Garnet in the 1932 and 1934 and Reward in the 1934 ex Atlantic samples had a depressing effect on the protein content of these cargo shipments. Similarly, the presence of Garnet and Reward in the 1932 and to a lesser extent in the 1933 and 1934 ex Pacific samples had a depressing effect on the protein content of these cargo shipments.

Three possible explanations might be given for this behaviour. These two varieties must be inherently lower in protein content than Marquis, or the wheat of these two varieties going into the Cargo samples was drawn from districts yielding wheat lower in protein content, or the two varieties are both inherently lower in protein content than Marquis and were grown in districts yielding wheat of lower protein. Taking the first of

these assumptions we find from data secured by the Cereal Division on samples of Marquis, Garnet, and Reward grown under comparable environmental conditions since 1924, that while Garnet is slightly lower in protein content than Marquis, Reward is distinctly higher. For 75 direct comparisons between Garnet and Marquis, the former has averaged .45% lower in wheat protein than the latter, and for 78 direct comparisons between Reward and Marquis, Reward averaged 1.68% higher than Marquis. Therefore, the presence of Garnet might have a tendency to lower the protein content of a cargo sample and Reward might tend to increase it for the same reasons. These varietal differences, however, are greatly overshadowed by differences in environment, as demonstrated quite clearly by the annual protein surveys of the Dominion Grain Research Laboratory. Samples from different localities in Manitoba, Saskatchewan and Alberta may have a protein range from 8.0 to 20.0% in any one crop year. In addition, these surveys indicate that the plains area of Southern Manitoba, Southern and Central Saskatchewan and Southern Alberta are the districts where the highest protein wheat is grown, and the northern parts of these provinces where the *lowest protein wheat* is normally grown. In view of the fact that the chief merit of Garnet and Reward lies in their early ripening characteristics, and that the growing of these two varieties (especially the former) is largely concentrated in the northern parts of these provinces, it is logical to assume that they would ordinarily have a tendency to depress the protein content of any cargo. *It is therefore maintained that the variability in protein occurring in the different cargo samples is very largely* dependent on the districts from which the wheat is drawn to make up these cargoes.

DISCUSSION

The data given in this paper is fairly representative in respect to the total wheat crop harvested in the prairie provinces each year as indicated in Table 6. However, there is little doubt that the extent of the crop for any one year would have a marked influence on varietal composition of export wheat. Large districts in the plains area have in periods such as the past few years contributed much less wheat than normal to the total crop, due to drought or rust, while large districts in the north in other years have been excluded from contributing much wheat to the contract grades due to early frost. Notwithstanding these variations, we do find that Marquis is becoming less and less prominent in our export wheat. Garnet, Reward and varieties such as Red Bobs and Ceres of the "good" quality group are making headway in the shipments. Since Garnet is not classed as equal to Marquis, special mention is made of this variety.

The data revealed that the percentage composition of the Manitoba 2 and 3 Northern cargo samples for the Garnet variety was, on the average, fairly high in the ex Atlantic samples and quite high in the ex Pacific samples. This would indicate that quite a volume of this variety is now being grown in Western Canada. It has been estimated at various times to be equal to 15 to 20% of the total crop.

Our knowledge of the districts where Garnet is chiefly grown would lead us to conclude that this variety is especially valuable to the grower in the northern parts of Saskatchewan and Alberta. On the other hand it is clear that the environment of these northern districts militates against

the production of wheat as high in protein as that grown in the southern districts where Marquis still reigns supreme. The setting up of separate grades for Garnet, namely 1 C.W. and 2 C.W. Garnet beginning with the 1935 crop and the withdrawal of this variety from the Manitoba 2 Northern grade should tend to segregate the northern grown wheat more and more from the southern grown wheat and thus bring the Manitoba 2 Northern grade more in line with Manitoba 1 Hard and Manitoba 1 Northern in respect to the grades representing our strongest wheat. Future studies will prove or disprove this assumption.

SUMMARY

Varietal analysis of the minimum Standard and Export Standard samples of the Western Grain Inspection Division, Winnipeg, has been made, extending over a period from 1926 to 1934 inclusive and of samples from Cargo shipments from 1928 to 1934 inclusive. Only the contract grades Manitoba 1, 2, and 3 Northern have been considered in this survey.

The study has revealed that Marquis is the predominant variety found in the Manitoba 1 Northern grade, followed by varieties classed as "good" bread wheats or those which compare favourably with Marquis in essential milling and baking characteristics. From 1930 to 1934 Reward, a high quality variety was found up to 10.9% in the cargo shipment samples. The varieties classed as "fair to poor" quality wheats decreased rapidly after 1929 and only appeared in low percentages from 1930 to 1934. Garnet was not found except in low percentages in this grade.

In the Manitoba 2 Northern grades, Marquis was found to be the predominant variety in the standard samples and in the cargo samples prior to 1930. While the Standard samples indicated a good percentage of Garnet from 1930 to 1934, the cargo samples presented a somewhat different picture. The ex Atlantic shipments showed a wide variation in the percentages of Marquis and Garnet present, although Marquis was on the average higher than Garnet for each crop year. In the ex Pacific samples, Garnet was the predominant variety and a steady increase in the percentages of this variety was shown each year, with a corresponding lowering in the percentages of Marquis and wheats classed as "good" quality varieties.

Similarly the data revealed somewhat the same trend of varietal composition in the Manitoba 3 Northern grades as in the Manitoba 2 Northern grades except for the lower percentages of Garnet.

The varietal analyses for the cargo shipments were not in agreement with the varietal analyses for the Standards, especially for the Manitoba 2 and 3 Northern grades. This is explained chiefly by the fact that the Standard samples are made up early in the crop year, while the cargo samples were secured over a longer period and therefore included more of the wheat grown in the northern districts where Garnet is the chief variety grown.

Varieties other than Marquis, Garnet, Reward and those grouped as "good" quality wheats do not appear except in low percentages after 1928. Red Bobs and Red Bobs selections and Ceres are the chief contributors to the "good" quality wheats while other varieties of this group occur rarely.

Protein determinations made on the cargo samples for 1932, 1933 and 1934 indicate that the Atlantic shipments and Pacific shipments for the Manitoba 1 Northern grade average about the same although considerable variation occurs between the different cargo samples. For the Manitoba 2 and 3 Northern grades, the ex Pacific shipments average substantially less than the ex Atlantic samples. The variability for both the ex Atlantic and ex Pacific samples is quite high and on the whole much greater for the ex Atlantic than for the ex Pacific.

Beginning with the 1935 crop, Garnet will be segregated from the Manitoba 2 Northern grade. This should have a substantial effect in improving the quality and uniformity of this grade since it will remove a wheat differing in milling qualities from Marquis and one which is largely grown in the northern areas.

ACKNOWLEDGMENTS

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REFERENCE

Malloch, J. G., W. F. Geddes, and R. K. Larmour. The relative milling and baking quality of Canadian spring wheat varieties. Can. J. Res. *6*. April, 1932.

Résumé

Composition des variétés de blé de printemps rouge dur canadien. J. G. C. Fraser et A. G. O. Whiteside, service des céréales, Ferme expérimentale Centrale, Ottawa, Canada.

L'analyse des variétés d'échantillons de blé du type modèle minimum et du type modèle (standard) d'exportation fournis par le Service d'inspection de grains de l'Ouest, Winnipeg, couvre la période de 1926 à 1934 inclusivement, et celle des échantillons de cargaison de 1928 à 1934 inclusivement. Il n'a été considéré dans cette étude que les catégories de contrat Manitoba 1, 2 et 3 du Nord. Cette enquête a revélé que le Marquis est la variété prédominante dans ces échantillons, dans toutes les trois catégories. Après 1929, les variétés classées de "passables à pauvres" ont diminué rapidement. Les analyses des variétés pour l'expédition par navires ne concordaient pas avec les analyses pour les types modèles, spécialement en ce qui concerne les catégories Manitoba 2 et 3 du Nord. Ceci s'explique principalement par le fait que les échantillons standard sont préparés au commencement de l'année de récolte, tandis que les échantillons de cargaison étaient recueillis pendant une plus longue période et qu'ils comprenaient par conséquent une plus grande partie du blé cultivé dans les parties nord où le Garnet est la principale variété. Les déterminations de protéine faites sur les échantillons de cargaison pour les années 1932, 1933 et 1934 indiquent que les expéditions sur l'Atlantique et sur le Pacifique pour la catégorie Manitoba 1 du Nord sont à peu près les mêmes, mais il y a une variation considérable entre les différents échantillons de cargaisons. Pour les catégories Manitopa 2 et 3 du Nord, les expéditions provenant du Pacifique sont sensiblement inférieures aux échantillons provenant de l'Atlantique. La variation constatée dans les échantillons de l'Atlantique et du Pacifique est très élevée, et elle est en somme beaucoup plus grande pour l'Atlantique que pour le Pacifique.

RESULTS WITH FERTILIZERS ON THE RED RASPBERRY

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Many experiments have been carried on by experiment stations in order to obtain information on the use of fertilizers for the principal fruits, and various recommendations based on the results of these experiments have been made. On account of soil differences the results vary considerably so that at times growers are rather undecided as to the use of fertilizers; this is particularly true with the red raspberry. For this fruit the value of a fertile soil, plentifully supplied with organic matter, is usually stressed, but so far there is considerable uncertainty as to the use of mineral fertilizers.

Stene (*6*) in Rhode Island states that, "the best yield of red raspberries has been secured from a fertilizer containing all three elements, nitrogen, phosphoric acid and potash. Leaving potash out of the fertilizer reduced the total yield for three seasons to less than one-half of that harvested from the plot receiving 'complete' fertilizer. Leaving out nitrogen reduced the yield about 30 percent and omitting phosphoric acid about 20 percent." Stene (*7*) in a later and more extensive experiment, but on a different soil, reports similar results. Hoblyn (*3*) in England, reports that, "The results indicate, on this soil, with two varieties of very different habit, a proper balance between nitrogen and potash (sulphate) is the secret of successful manuring of raspberries. Nitrogen may, up to a point, produce more cane by itself but has never increased the crop except in the presence of potash. Indeed, alone, it has been depressing in both cases." Woods (*8*) in British Columbia states that "in unfinished experiments . . . . . nitrate of soda increases cane growth more than any other single element tried, that in combination nitrate of soda and superphosphate of lime have produced the greatest amount of growth, and that muriate of potash, at the rate of 1,000 pounds per acre, inhibits growth."

As several authors, notably Stene (*6*), Shoemaker (*5*) and Woods (*8*) have recently reviewed the literature fairly extensively it is not necessary to repeat here.

It is evident that different results may be expected with fertilizers under different environmental conditions, hence the conditions under which this experiment was conducted are given in some detail.

EXPERIMENTAL CONDITIONS

This experiment was conducted at the Horticultural Experiment Station at Vineland, which is situated in the tender fruit section of the Niagara Peninsula where most of the raspberries produced in Ontario are grown. The climatic conditions, however, are not ideal for the raspberry, as summer heat and drought are apt to curtail the crop and sudden changes of temperature in winter with light snow covering may cause serious winter injury.

The soil of the experimental area is classified in the Ontario Soil Survey as Vineland Fine Sandy Loam. In general it is described as an

imperfectly drained brown sandy loam underlaid with clay, having a fair supply of organic matter and being moderately acid. It is used quite extensively for peaches, small fruits and vegetable crops.

By actual test, using the Quinhydrone method, both the surface soil (1–8 inches) and the subsoil (8–18 inches) were found to be slightly acid —pH 6.5 for the former and pH 6.6 for the latter. This was in April, 1932 before any fertilizers were applied. After three years of fertilizer applications, October, 1934, there was a slight trend towards higher pH values; some of the subsoil samples actually were slightly alkaline. As there appeared to be no consistent change in pH for any particular treatment it would seem that other factors were responsible for the changes.

Chemical tests for the two principal mineral constituents showed that this soil was well supplied with readily available phosphorus but was rather low in replaceable potassium. The quantities of these minerals as determined by the tests are given in Tables 1A and 1B.

TABLE 1A.—READILY AVAILABLE PHOSPHORUS IN THE EXPERIMENTAL PLOTS BEFORE AND AFTER FERTILIZER APPLICATIONS

1932—before fertilizer applications			1934—after three annual applications of fertilizers (see Table 2)	
Surface soil 1–8 inches	Sub soil 8–18 inches		Surface soil 1–8 inches	Sub soil 8–18 inches
(1)				
74.4	59.9	O	70.3	65.7
81.3	57.7	N	77.7	57.3
71.7	66.4	K	72.0	68.9
74.4	54.6	NK	68.6	67.8
75.4	59.6	Means	72.1	65.0
81.3	68.2	P	147.9	86.6
74.0	67.5	NP	148.3	71.8
78.3	66.6	PK	146.4	59.9
74.2	60.4	NPK	161.5	66.4
77.0	65.7	Means	151.0	71.2

(1) Parts per million—means of 8 plots. Readily available phosphorus determined by $KHSO_4$ method (4).

TABLE 1B.—REPLACEABLE POTASSIUM IN THE EXPERIMENTAL PLOTS BEFORE AND AFTER, FERTILIZER APPLICATIONS

1932—before fertilizer applications			1934—after three annual applications of fertilizers (see Table 2)	
Surface soil 1–8 inches	Sub soil 8–18 inches		Surface soil 1–8 inches	Sub soil 8–18 inches
(1)				
10.2	6.2	O	7.5	6.2
10.3	6.9	N	5.9	6.6
10.9	6.9	P	6.2	6.6
10.3	6.2	NP	6.6	5.6
10.4	6.5	Means	6.5	6.2
10.6	5.9	K	19.1	8.7
10.6	6.9	NK	17.8	7.5
10.6	6.6	PK	18.7	7.8
10.6	6.6	NPK	18.7	7.5
10.6	6.5	Means	18.6	7.9

(1) Parts per million—means of 8 plots. Replaceable potassium determined by sodium chloride method.

That the soil was too low in potassium for the raspberry was shown in the leaves which exhibited very marked potassium deficiency symptoms (Figure 1). Phosphorus deficiency symptoms were not found in any of the plots.

Judging from surface appearances this soil would be considered very uniform. Numerous borings, however, reveal quite marked variations in depth and texture of the several horizons. The A horizon is a fine sandy loam which has an average depth of about eight inches with extremes of four to twelve. The B horizon is mainly a very fine sand, usually of a yellowish brown colour, although sometimes grayish, but with lenses of clay and sand mixture of various sizes and thicknesses interspersed throughout, and it rests entirely on a heavy impervious clay at 3 ft. to 7 ft. 6 ins. which constitutes the C horizon.

As there is a gradual fall in the ground level from south to north of about $6\frac{3}{4}$ ins. per 100 ft., with no marked hills or depressions, surface drainage would seem to be adequate. Underdrainage also is well provided for as there are four rows of 4-inch tile, spaced 24 ft. apart and running lengthwise of the plantation. These, however, may not be functioning to their full capacity as they tend to fill up with fine soil particles.

In order to get some idea of the movement of water in the soil the rise and fall of the water table was recorded from November, 1931, to June, 1934. Measurements were made in 1-inch iron pipes let into the ground down to the parent clay. The water was free to pass into or out of the pipes as the bottom of each pipe rested on small pieces of stone. Water readings were taken periodically with a measuring stick, due allowance being made for the volume of the stick.

It was found that the water level fluctuated considerably. During the first half of each year it was invariably much higher than in the second half, also in a moist season it was considerably higher than in dry seasons. In the moist season (1932) some water was present in a few holes all through the summer and fall, except in October, while in the dry seasons (1933 and 1934) the holes were practically dry after the middle of June. At no time however was the water table nearer than 20 inches to the ground level and usually was much lower. It would seem therefore that drainage was satisfactory.

Weather conditions varied considerably during the five years of the experiment. In 1930 (year of planting) and 1931 conditions were moderately favourable for the raspberry and so the plantation became well established. The season of 1932 was very favourable, with plentiful precipitation and moderate temperatures, particularly during the growing and fruiting period. This, however, was followed by drought in 1933 and 1934 which, with unusually low temperatures and light snow covering in January and February, 1934, led to much killing back of canes and probably to serious root injury.

Disease, principally mosaic, did not show up to any extent until 1933 but it became very prevalent late in 1934 and 1935, so much so in fact, that it was thought inadvisable to take fruit records after 1934, although the experiment was not actually terminated until 1935.

The effect of previous soil treatments on crops that follow is of importance in experimental work, especially when the soil is to be used for

FIGURE 1.—Normal raspberry foliage on left. Foliage showing potassium deficiency symptoms on right.

fertilizer tests, hence the history of the area in question is given in detail. It comprised one and one-half acres of a six-acre field in a farm that had been used many years for general farming, principally grain growing and was rather badly run down, being low in organic matter, when taken over by the Experiment Station in 1916.

Ground limestone, at the rate of two tons per acre, was applied to the six-acre field in 1918; it was then sown to green manuring crops. In 1920 it was used for vegetable crops. The next year it was planted to peach trees, these, however, were removed in 1927 on account of their unthrifty condition including several deaths. From 1919 to 1923 inclusive the area eventually planted to the raspberry experiment received fifteen tons of manure per acre per year, and several green manuring crops were plowed under from 1924 to 1930.

Just previous to raspberry planting the ground was plowed and subsoiled to a depth of 12 to 14 inches. The actual planting was done in the spring of 1930 and the plants were set 6 feet by 6 feet on the square (see Figure 2).

The Viking variety was used, as it is well adapted to the district, and a stock of apparently disease-free plants was on hand. In spite of the dry spring most of the young plants made a fairly good start, but 10% had to be replaced.

EXPERIMENTAL METHODS

This experiment was planned to include plot treatments as shown in Figure 2. Nitrogen was supplied as nitrate of soda, phosphorus as superphosphate and potassium as sulphate of potash.

The criteria of fertilizer effects were the amount of plant growth—"wood", and fruit yields—"fruit".

The space available and the number of plants in the experiment permitted the use of sixty-four plots—16 plants to each—with buffer rows between all plots in both directions. This number of plots allowed for eight replications of each of the eight treatments. The whole area was divided into eight blocks each containing eight plots, and the eight treatments were assigned at random to the plots within each block. This modified randomization of plots (see Figure 2) permitted the use of the "Analysis of Variance" method of analysing the yield data (1, 2).

The fertilizers were applied in May in three successive years, 1932, 1933 and 1934. Rates of application and dates of sowing are given in Table 2.

Table 2.—Rates per acre and dates of sowing the fertilizers

Fertilizers used	1932(1)		1933(1)		1934(2)	
	Date	Rate, lbs.	Date	Rate, lbs.	Date	Rate, lbs.
Nitrate of soda (15.5%)	May 19	300	May 3	600	May 15	600
Superphosphate (16%)	May 19	750	May 4	1200	May 2	1200
Sulphate of potash (48.7%)	May 20	480	May 3	480	May 2	480

(1) Fertilizers worked into the ground by spring-tooth cultivator several days after sowing.
(2) Superphosphate and Potash plowed under immediately after sowing. Nitrate worked in by cultivator.

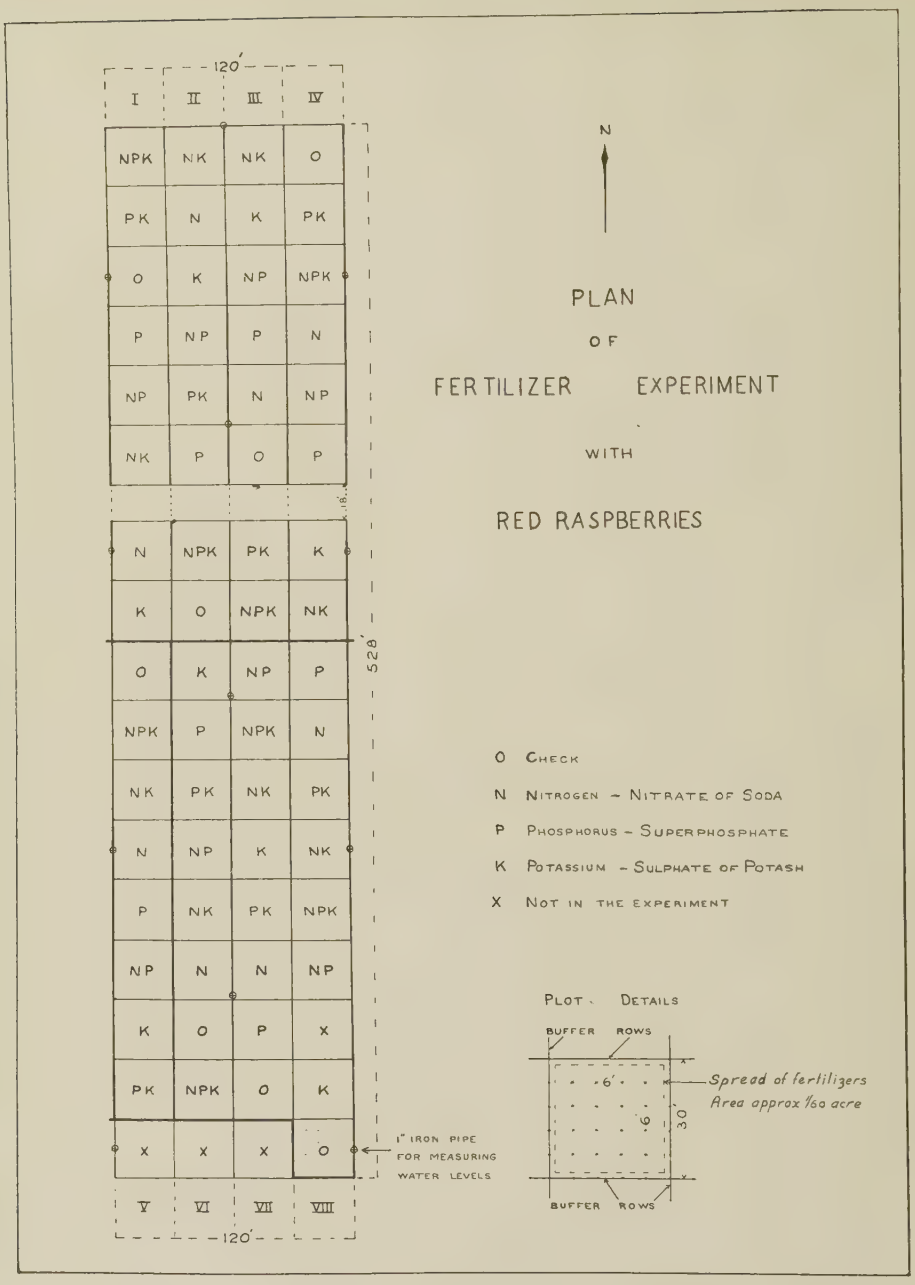

FIGURE 2

The plantation received the usual care given to raspberries. It was plowed once each year and cultivated until fruit was ready to pick. After fruit picking was finished the ground was cleaned up and left until fall or spring when it was plowed.

The annual pruning consisted of the removal of old fruiting wood, on the completion of fruit picking, the removal of surplus canes (7 or 8

per plant being retained), and the heading back of those left. The last operation was deferred until spring so that the degree of winter injury, if any, could be noted. Normally canes were cut off at about two-thirds of their height but if any injured canes had to be retained these were pruned well below the injured portion.

In order to measure growth differences, all prunings were weighed immediately a plot was completed. This was considered to be a more reliable index of plant vigour than individual cane measurements.

It should be noted that a year's total growth—say for 1932— included the spring prunings removed in 1932, which actually had grown in 1931, and the current year's fruiting wood, removed in late summer.

Fruit picking was carried on over the period of profitable commercial returns.

The dates when picking began and ended and the number of pickings made each year are shown in Table 3.

TABLE 3.—PICKING DATES AND NUMBER OF PICKINGS MADE EACH YEAR

1932(1)		1933(2)		1934(2)	
Dates	Pickings	Dates	Pickings	Dates	Pickings
July 16 to Aug. 15	12	July 8 to July 25	8	July 16 to July 30	7

(1) Nearly all the fruits developed and ripened.
(2) Many fruits failed to develop to full size but dried up on the plants.

FERTILIZER RESULTS

The yields for several plots, where plants were missing, were adjusted by multiplying the mean for the plants left in the plot by 16, the complete plot number. Growth and yield data for four years are given in Table 4.

TABLE 4.—WOOD AND FRUIT YIELDS IN POUNDS FOR 1931 TO 1934

1931 (no fertilizer)			1932		1933		1934	
Wood	Fruit	Treatments	Wood	Fruit	Wood	Fruit	Wood	Fruit
(1) 18.3	21.9	O	69.3	83.9	29.1	21.0	18.3	14.6
19.9	24.1	N	87.6	92.5	33.1	22.0	18.2	8.4
17.9	23.4	P	70.7	82.2	29.4	22.0	22.7	15.9
15.5	22.0	K	72.9	88.3	38.0	35.0	27.4	20.8
18.1	22.3	NP	80.8	95.9	34.6	23.4	19.8	11.9
18.0	24.1	NK	75.0	96.0	37.5	34.0	26.3	14.9
17.5	23.3	PK	71.0	88.7	34.0	35.0	31.1	24.6
17.9	24.5	NPK	84.0	107.6	39.4	36.0	27.6	14.1
1145.6	1568.0	Totals	4893.8	5883.9	2202.7	1821.6	1532.2	1003.2
17.9	23.2	General Mean	(2) 76.5	91.9	34.4	28.5	25.2	15.7
		Standard Error	4.17	4.97	2.23	1.72	2.16	1.49
		Significant Diff.	11.79	14.07	6.38	4.87	6.10	5.07

(1) Quantities of wood and fruit are the means of 8 plots each.
(2) G.M.; Std. Error and Sig: Diff: are for 64 plots.

It is obvious from Table 4 that there are marked differences in the aggregate yields of both wood and fruit for the different years, those for 1932 being the highest. These yearly differences were due no doubt to variations in season and also perhaps to age of plants. Plot differences within each year, however, must have been due to other causes. The yearly aggregate of these plot differences makes up the total amount of variation in the experiment for each year. This variation which is due to position, to treatment, and to that which is inherent in the material may be divided into these component parts by the "Analysis of Variance"; also the significance of differences may be tested. Actual analysis shows that the total variation due to treatment is significant but not all treatments give significant differences. Details of the analyses are not given but the differences required to be significant, to the 20 to 1 point, are shown in the tables of yield data.

Comparisons between plots treated differently must now be made so that differences due to treatments may be discovered, and to facilitate these comparisons Table 4 has been divided into several tables with the data rearranged. (See Tables 5 to 13.)

1932 Results

TABLE 5.—YIELDS OF WOOD AND FRUIT FOR 1932. ARRANGED FOR READY COMPARISON OF TREATMENTS

Wood, 1932						Fruit, 1932					
	O	P	K	PK	Mean (32 plots)		O	P	K	PK	Mean (32 plots)
	(1)						(2)				
No N	69.3	70.7	72.9	71.0	71.0	No N	83.9	82.2	88.3	88.7	85.8
N	87.6	80.8	75.0	84.0	81.8	N	92.5	95.9	96.0	107.6	98.0
Difference	18.3	10.1	2.1	13.0	10.8	Difference	8.6	13.7	7.7	18.9	12.2
	O	N	K	NK	Mean (32 plots)		O	N	K	NK	Mean (32 plots)
No P	69.3	87.6	72.9	75.0	76.2	No P	83.9	92.5	88.3	96.0	90.2
P	70.7	80.8	71.0	84.0	76.7	P	82.2	95.9	88.7	107.6	93.6
Difference	1.4	−6.8	−1.9	9.0	.4	Difference	1.7	3.4	.4	11.6	3.4
	O	N	P	NP	Mean (32 plots)		O	N	P	NP	Mean (32 plots)
No K	69.3	87.6	70.7	80.8	77.1	No K	83.9	92.5	82.2	95.9	88.6
K	72.9	75.0	71.0	84.0	75.7	K	88.3	96.0	88.7	107.6	95.1
Difference	3.6	−12.6	0.3	3.2	−1.4	Difference	4.4	3.5	6.5	11.7	6.5
(1) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 11.79					Sig. Diff. 5.88	(2) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 14.07.					Sig. Diff: 7.04

Table 5 shows that both wood and fruit were significantly higher in the nitrate plots than in the non-nitrate plots. Wood was the same on the phosphate plots as on the non-phosphate plots but fruit was somewhat higher on the phosphate plots, although not significantly so. On the

potash and non-potash plots the results were similar to the phosphate results but with fruit increases more nearly significant.

TABLE 6.—YIELDS OF WOOD AND FRUIT FOR 1932, COMPARING TREATMENTS SINGLY AND IN COMBINATION WITH ANOTHER TREATMENT

Wood, 1932				Fruit, 1932			
	No K	K	Difference		No K	K	Difference
	(1)				(2)		
No N	70.0	71.9	1.9	No. N	83.1	88.5	5.4
N	84.2	79.6	−4.6	N	94.2	101.8	7.6
Difference	14.2	7.7		Difference	11.1	13.3	
	No N	N	Difference		No N	N	Difference
No P	71.1	81.3	10.2	No P	86.1	94.2	8.1
P	70.9	82.5	11.6	P	85.5	101.8	16.3
Difference	−0.2	1.2		Difference	−0.6	7.6	
	No P	P	Difference		No P	P	Difference
No K	78.4	75.8	−2.6	No K	88.2	89.1	0.9
K	74.0	77.6	3.6	K	92.1	98.2	6.1
Difference	−4.4	1.8		Difference	3.9	9.1	

(1) Means for 16 plots. Sig: Diff: between each pair of means 8.34.

(2) Means for 16 plots. Sig: Diff: between each pair of means 9.95.

TABLE 7.—YIELDS OF WOOD AND FRUIT FOR 1932, COMPARING A DOUBLE AND A TRIPLE COMBINATION—NK WITH NPK

Wood, 1932						Fruit, 1932					
Without phosphate			With phosphate			Without phosphate			With phosphate		
	No N	N		No N	N		No N	N		No N	N
	(1)						(2)				
No K	69.3 (O)	87.6 (N)	No K	70.7 (P)	80.8 (NP)	No K	83.9 (O)	92.5 (N)	No K	82.2 (P)	95.9 (NP)
K	72.9 (K)	75.0 (NK)	K	71.1 (PK)	84.0 (NPK)	K	88.3 (K)	96.0 (NK)	K	88.7 (PK)	107.6 (NPK)

(1) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 11.79.

(2) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 14.07.

From Tables 6 and 7 it will be seen that there was a marked tendency for the three fertilizers (Nitrate of soda, superphosphate, and sulphate of potash) to act independently of each other rather than together. For example, in the nitrate-phosphate combination wood was increased significantly whether nitrate was used alone or with phosphate but there was no increase from the phosphate treatments with nitrate or without nitrate.

1933 Results

TABLE 8.—YIELDS OF WOOD AND FRUIT FOR 1933. ARRANGED FOR READY COMPARISON OF TREATMENTS

Wood, 1933

	O	P	K	PK	Mean (32 plots)
	(1)				
No N	29.1	29.4	38.0	34.0	32.6
N	33.1	34.6	37.6	39.4	36.1
Difference	4.0	5.2	−0.5	5.4	3.5
	O	N	K	NK	Mean (32 plots)
No P	29.1	33.1	38.0	37.5	34.4
P	29.4	34.6	34.0	39.4	34 3
Difference	0.3	1.5	−4.0	1.9	0.1
	O	N	P	NP	Mean (32 plots)
No K	29.1	33.1	29.4	34.6	31.5
K	38.0	37.5	34.0	39.4	37.2
Difference	8.9	4.8	4.6	4.8	5.7

(1) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 6.38. Sig: Diff: 3.18

Fruit, 1933

	O	P	K	PK	Mean (32 plots)
	(2)				
No N	21.0	21.7	35.0	35.2	28.2
N	21.7	23.4	33.8	35.9	28.7
Difference	0.7	1.7	−1.2	0.7	0.5
	O	N	K	NK	Mean (32 plots)
No P	21.0	21.7	35.0	33.8	27.9
P	21.7	23.4	35.2	35.9	29.0
Difference	0.7	1.7	0.2	2.1	1.1
	O	N	P	PK	Mean (32 plots)
No K	21.0	21.7	21.7	23.4	21.9
K	35.0	33.8	35.2	35.9	35.0
Difference	14.0	12.1	13.5	12.5	13.1

(2) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 4.87. Sig: Diff: 2.42

It will be seen from Table 8 that the nitrate plots gave significant increases in wood over the non-nitrate plots but that in fruit there was no difference. For the phosphate plots the wood was the same as for the non-phosphate plots, while fruit was somewhat higher but not significantly The results on the potash plots are worthy of note. For both wood and fruit, the increases for the potash over the non-potash plots were highly significant, particularly so for fruit.

TABLE 9.—YIELDS OF WOOD AND FRUIT FOR 1933, COMPARING TREATMENTS SINGLY AND IN COMBINATION WITH ANOTHER TREATMENT

Wood, 1933

	No K	K	Difference
	(1)		
No N	29.3	36.1	6.8
N	33.8	38.4	4.6
Difference	4.5	2.3	
	No N	N	Difference
No P	33.5	35.3	2.2
P	31.8	37.0	5.2
Difference	−1.7	1.7	
	No P	P	Difference
No K	31.6	32.0	0.4
K	37.7	36.8	−0.9
Difference	6.1	4.8	

Fruit, 1933

	No K	K	Difference
	(2)		
No N	21.4	35.1	13.7
N	22.5	34.9	12.4
Difference	1.1	−0.2	
	No N	N	Difference
No P	28.0	27.7	− 0.3
P	28.4	29.6	1.2
Difference	0.4	1.9	
	No P	P	
No K	21.4	22.5	1.1
K	34.5	35.5	1.0
Difference	13.1	13.0	

(1) Means for 16 plots. Sig: Diff: between each pair of means 4.50.
(2) Means for 16 plots. Sig. Diff: between each pair of means 3.42.

TABLE 10.—YIELDS OF WOOD AND FRUIT FOR 1933, COMPARING A DOUBLE AND A TRIPLE COMBINATION—NK AND NPK

Wood, 1933						Fruit, 1933					
Without phosphate			With phosphate			Without phosphate			With phosphate		
	No N	N		No N	N		No N	N		No N	N
	(1)						(2)				
No K	29.1 (O)	33.1 (N)	No K	29.4 (P)	34.6 (NP)	No K	21.0 (O)	21.7 (N)	No K	21.7 (P)	23.4 (NP)
K	38.0 (K)	37.5 (NK)	K	34.0 (PK)	39.4 (NPK)	K	35.0 (K)	33.8 (NK)	K	35.2 (PK)	35.9 (NPK)

(1) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 6.38.
(2) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 4.87.

The tendency for the fertilizers used to act independently is again strongly suggested from the results shown in Tables 9 and 10. For example, in the potash-phosphate combination with fruit— the phosphate and non-phosphate plots gave the same differences whether they received potash or not, also the potash and non-potash plots gave the same differences with and without phosphate.

1934 Results

TABLE 11.—YIELDS OF WOOD AND FRUIT FOR 1934. ARRANGED FOR READY COMPARISON OF TREATMENT

Wood, 1934						Fruit, 1934					
	O	P	K	PK	Mean (32 plots)		O	P	K	PK	Mean (32 plots)
	(1)						(2)				
No N	18.3	22.7	27.4	31.1	24.8	No N	14.6	15.9	20.8	24.6	19.0
N	18.2	19.8	26.3	27.6	23.0	N	8.4	11.9	14.9	14.1	12.3
Difference	−0.1	−2.9	−1.1	−3.5	−1.8	Difference	−6.2	−4.0	−5.9	−10.5	−6.7
	O	N	K	NK	Mean (32 plots)		O	N	K	NK	Mean (32 plots)
No P	18.3	18.2	27.4	26.3	22.5	No P	14.6	8.4	20.8	14.9	14.7
P	22.7	19.8	31.1	27.6	25.3	P	15.9	11.9	24.6	14.1	16.6
Difference	4.4	1.6	3.7	1.3	2.7	Difference	1.3	3.5	3.8	−0.8	1.9
	O	N	P	PK	Mean (32 plots)		O	N	P	PK	Mean (32 plots)
No K	18.3	18.2	22.7	19.8	19.7	No K	14.6	8.4	15.9	11.9	12.7
K	27.4	26.3	31.1	27.6	28.1	K	20.8	14.9	24.6	14.1	18.6
Difference	9.1	8.1	8.4	7.8	8.3	Difference	6.2	6.5	8.7	2.2	5.9
(1) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 6.10.					Sig: Diff: 3.04	(2) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 5.07.					Sig: Diff: 2.52

In Table 11 decreases in both wood and fruit are shown that were obtained on the nitrate plots over the non-nitrate plots; in fruit the decrease in yield was significant. On the other hand, there were marked increases in wood and fruit for the phosphate over non-phosphate plots, but not quite enough to be significant, while the potash plots gave significant increases over the non-potash for both wood and fruit.

TABLE 12.—YIELDS OF WOOD AND FRUIT FOR 1934, COMPARING TREATMENTS SINGLY AND IN COMBINATION WITH ANOTHER TREATMENT

Wood, 1934				Fruit, 1933			
	No K	K	Difference		No K	K	Difference
	(1)			(2)			
No N	20.5	29.2	8.7	No N	15.2	22.7	7.5
N	19.0	27.0	8.0	N	10.2	14.5	4.3
Difference	−1.5	−2.2		Difference	−5.0	−8.2	
	No N	N	Difference		No N	N	Difference
No P	22.9	22.3	−0.6	No P	17.7	11.7	−6.0
P	26.9	23.7	−3.2	P	20.2	13.0	−7.2
Difference	4.0	1.4		Difference	2.5	1.3	
	No P	P	Difference		No P	P	Difference
No K	18.3	21.2	2.9	No K	11.5	13.9	2.4
K	26.9	29.3	2.4	K	17.9	19.4	1.5
Difference	8.6	8.1		Difference	6.4	5.5	

(1) Means for 16 plots. Sig: Diff: between each pair of means 4.32.
(2) Means for 16 plots. Sig: Diff: between each pair of means 3.58.

TABLE 13.—YIELDS OF WOOD AND FRUIT FOR 1934, COMPARING A DOUBLE AND A TRIPLE COMBINATION—NK WITH NPK

Wood, 1934						Fruit, 1934					
Without phosphate			With phosphate			Without phosphate			With phosphate		
	No N	N		No N	N		No N	N		No N	N
	(1)						(2)				
No K	18.3 (O)	18.2 (N)	No K	22.7 (P)	19.8 (NP)	No K	14.6 (O)	8.4 (N)	No K	15.9 (P)	11.9 (NP)
K	27.4 (K)	26.3 (NK)	K	31.1 (PK)	27.6 (NPK)	K	20.8 (K)	14.9 (NK)	K	24.6 (PK)	14.1 (NPK)

(1) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 6.10.
(2) Means of 8 plots per treatment. Sig: Diff: between each pair of means is 5.07.

TABLE 14.—RESULTS OF FERTILIZER TREATMENTS BRIEFLY TABULATED

Treatments	1932		1933		1934	
	Wood	Fruit	Wood	Fruit	Wood	Fruit
N	Highly significant increase	Highly significant increase	Significant increase	No effect	Small decrease	Highly significant decrease
P	No effect	Small increase	No effect	Small increase	Almost significant increase	Almost significant increase
K	Slight decrease	Almost significant increase	Highly significant increase	Highly significant increase	Highly significant increase	Highly significant increase
Combinations	No inter-actions	No inter-actions	No inter-actions	No inter-actions	No inter-actions	No inter-actions

The data in Tables 12 and 13 appear to confirm the tendency of the fertilizers used to act independently in the several combinations. For further example, with fruit, the nitrate plots showed significant decreases over the non-nitrate whether potash was present or not. Also, the potash plots gave significant increases over the non-potash plots both with and without nitrate.

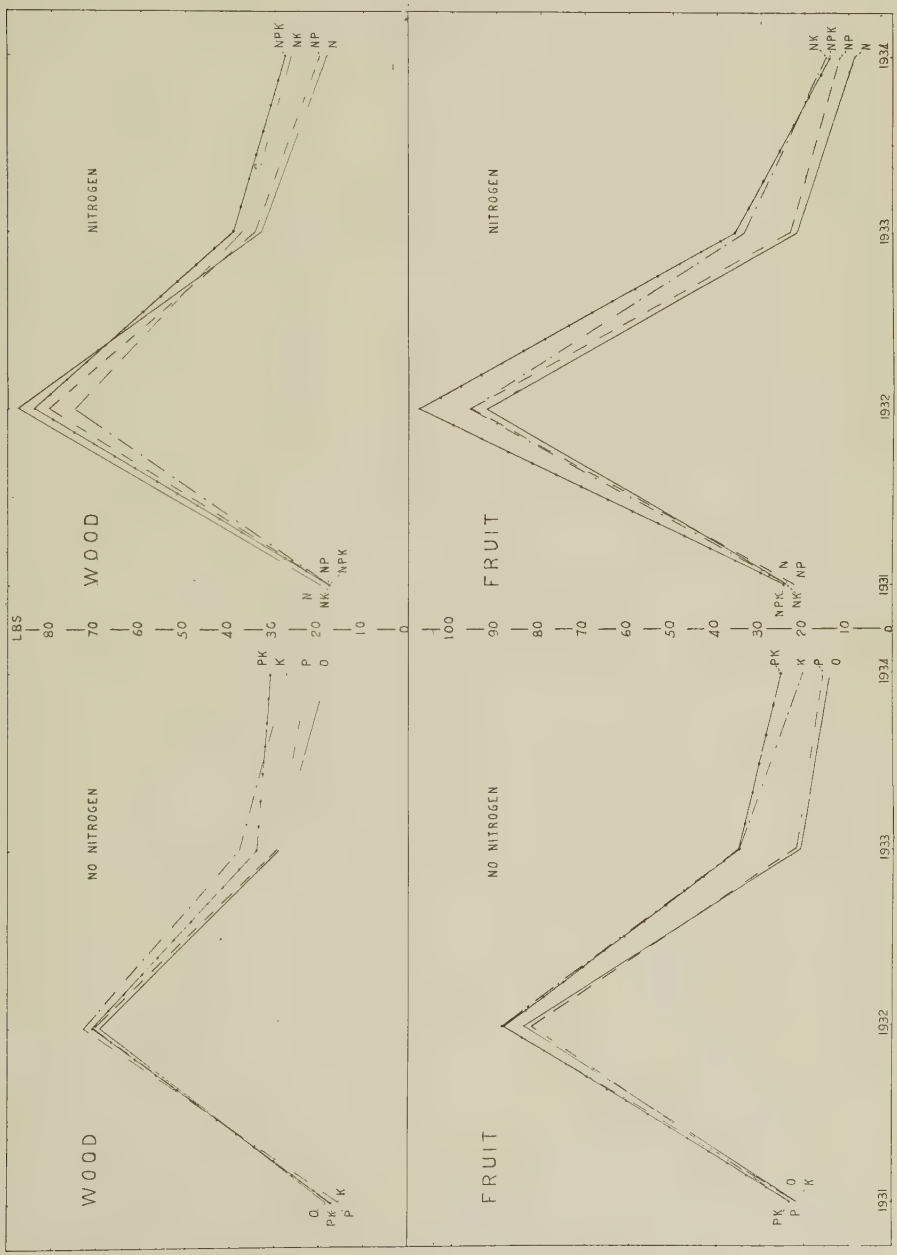

FIGURE 3.—Weights of wood and fruit, shown graphically: fertilizer applications made in 1932, 1933 and 1934.

This lack of interaction between these three fertilizers is not so clear in all cases but the general tendency is apparent.

The three year's results are summarized in Table 14, and are shown graphically in Figure 3.

Besides the increases or decreases in wood and fruit due to fertilizer treatments, the differences in the ratio of wood to fruit are also of interest; these are shown in the diagram (Figure 4).

It will be observed that the proportion of fruit to wood decreased each year for all treatments—except for the check plots in 1934—but particularly for the nitrate plots.

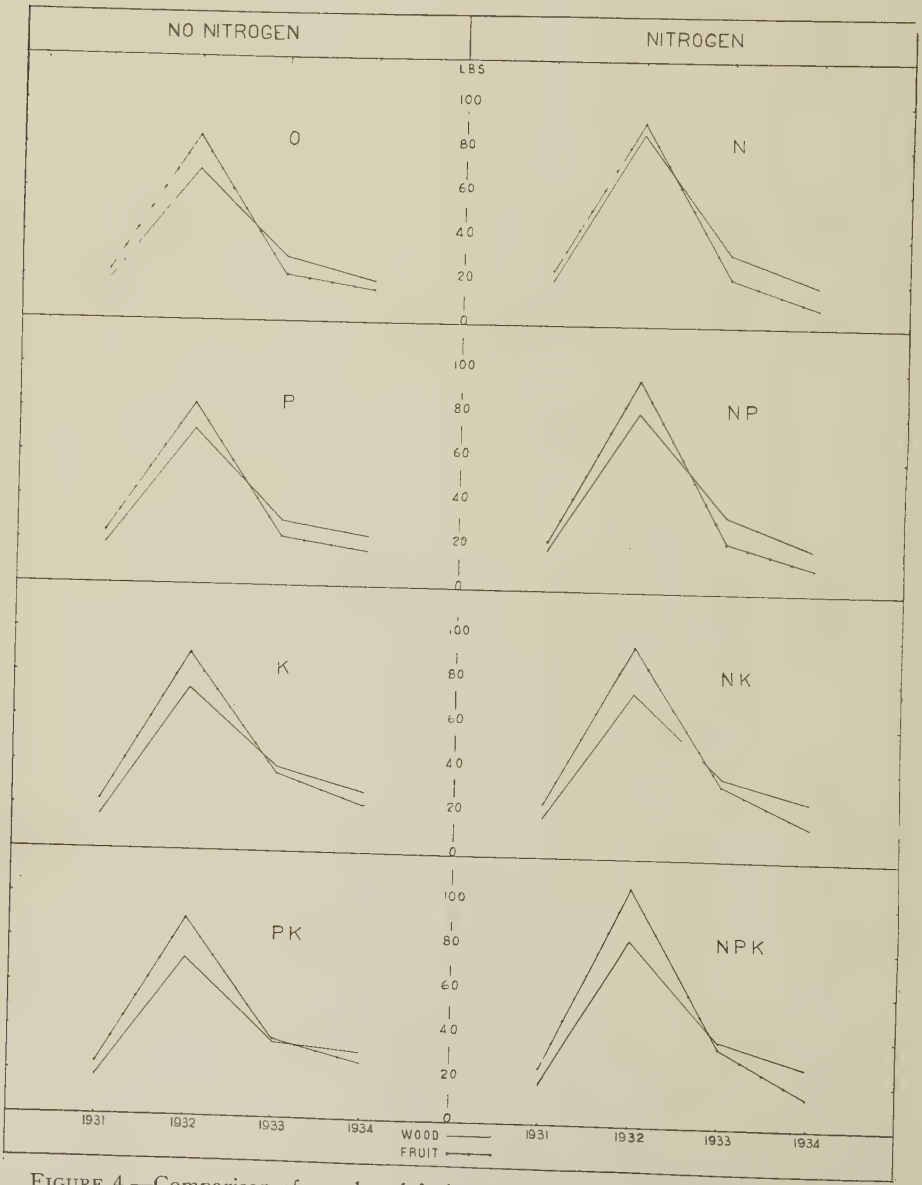

FIGURE 4.—Comparison of wood and fruit weights from plots without nitrogen and with nitrogen.

DISCUSSION

Probably the most notable feature of this experiment was the marked difference, for both wood and fruit, between each year's results for the whole experiment, particularly in the plots receiving nitrate of soda (See Table 4).

As already noted (under experimental conditions), the weather varied greatly from year to year. In 1931 and particularly in 1932, it was favourable for growth and fruitfulness, hence good growth and high yields were obtained in the latter year, over the whole plantation. However, in 1933 and 1934 it was unfavourable, with resulting reduction in yields.

All the plots that received nitrate of soda in 1932 did unusually well, as indicated by the significant increases in wood and fruit. Apparently in this season, the plants were able to make use of the extra nitrogen to a marked extent. In 1933 the nitrate plots gave significant increases in wood growth but without a corresponding increase in fruitfulness. This lack of fruit increase was due probably to the heavy application of nitrate of soda (applied early in May 1933—see Table 2), being coupled with a fairly good supply of moisture early in the season followed by drought in the latter part of June and all through July. These conditions, undoubtedly, would favour increased growth, particularly in leaf area during May and early June and thus increase the transpiration area. The ensuing drought with resultant dry soil conditions would curtail the supply of water available for transpiration and it would seem reasonable to suppose that the water of the whole plant, including the fruit, would be drawn on in an attempt to meet the demands of transpiration, thus preventing the fruit from developing properly and in extreme cases causing it to dry up on the plant. No particular effect on the "set" of fruit was noticed. In 1934 the bad effect of heavy nitrate of soda applications, under drought conditions, was further emphasized and it was undoubtedly aggravated by severe injury which occurred in the winter of 1933–34.

Actual injury to the roots by too great a concentration of salts in the soil is recognized as a possible factor in the poor results on plots receiving nitrate of soda in 1933 and 1934, but no data were obtained on this point.

The combination of unfavourable conditions undoubtedly played the major part in causing the great reduction in the proportion of fruit to wood in the nitrate plots. The age of the plants may also have been a factor.

Incidentally it is of interest to note that in the fall (October) of 1933 and 1934 evidence of the presence of excess nitrogen in the soil was seen in the very strong and green weed growth, mostly chickweed, in all plots that had received nitrate of soda. This suggests that nitrate of soda when applied in the spring (May) may at the end of a dry season still have a stimulating effect on raspberry plants which would not permit them to mature properly before winter.

There was no significant result from plots that received superphosphate. According to chemical analyses (Table 1A) the soil was already moderately well supplied with readily available phosphorus and so any extra might be of no immediate benefit, or the added phosphorus may not have been actually available to the plants, as in 1932 and 1933 it was worked into the soil with only the spring tooth cultivator and perhaps not very

effectively. In 1934, however, it was ploughed under immediately after sowing. This may account, in part at least, for the better results obtained in the phosphate plots in that year.

Without actual measurements, it would be very difficult to determine whether the extra phosphorus had any effect on the amount of winter injury, although from careful observations it appeared to be slightly less on the plots that received superphosphate.

Apparently there was no effect on the ratio of wood to fruit from the extra phosphorus.

The marked increases in yields of wood and fruit in 1933 and 1934 on the plots that received sulphate of potash suggest very strongly that this particular soil was not high enough in readily available potassium for the best results with the red raspberry. This suggestion is supported by the results of the soil analysis (Table 1B) and by the potassium deficiency symptoms shown in the leaves (Figure 1) which were typical of the plants in the plots that did not receive potash. It is of interest to note that deficiency symptoms were not apparent in 1932 (moist cool season) but were quite marked in 1933 and 1934 (both dry seasons).

It is difficult to account for the seeming lack of interaction between the fertilizers when used in combination, and it is not in accord with the results obtained by Hoblyn (*3*) in England who found that "Nitrogen may, up to a point, produce more cane by itself, but has never increased the crop except in the presence of potash."

According to the original plans addition of organic matter to certain plots was contemplated, but unfortunately, early termination of the experiment, because of the prevalence of disease (mosaic) made this impossible. However, any future experiments with fertilizers on the red raspberry should include organic matter as a major feature as undoubtedly it would have a marked bearing on the results.

SUMMARY

1. Tests with commercial fertilizers—nitrate of soda, superphosphate and sulphate of potash—were conducted with the Viking red raspberry, for three seasons at Vineland, Ontario.

2. Seasonal differences were of marked importance in these tests.

3. Nitrate of soda, 300 lbs. per acre, increased yields significantly in a comparatively cool moist season (1932) but, 600 lbs. per acre, decreased yields in dry seasons (1933 and 1934).

4. Superphosphate, 750 lbs. per acre in 1932, 1200 lbs. per acre in 1933 and 1934, gave no significant results. This particular soil was already moderately well supplied with readily available phosphorus.

5. Sulphate of potash, 480 lbs. per acre in 1932–33–34, gave significant increases in yields in 1933 and 1934. The soil was rather low in replaceable potassium.

6. There appeared to be no interactions between nitrate of soda, superphosphate and sulphate of potash in the several combinations.

ACKNOWLEDGMENTS

Thanks are due to Mr. T. N. Hoblyn, Statistician of the Horticultural Research Station, East Malling, England, for valuable assistance both in planning this experiment and in analysing the data; to Dr. W. H. Upshall of the Horticultural Experiment Station for suggestions regarding the conduct of the experiment and for reviewing the manuscript, and to Mr. J. R. vanHaarlem, also of the latter Station, for carrying out the chemical tests of the soil and for the original photograph of raspberry foliage showing symptoms of potassium deficiency. The helpful suggestions and constructive criticisms given by Mr. E. F. Palmer, Director of the Horticultural Experiment Station, are also gratefully acknowledged.

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Résumé

Essais d'engrais chimiques sur le framboisier à fruits rouges. W. J. Strong, station expérimentale d'horticulture de l'Ontario, Vineland Station, Ont.

Des essais d'engrais chimiques sur le framboisier à fruits rouges Viking (*Rubus idaeus x strigosus*), sur des sols sablo-argileux fins ont été effectués à Vineland. Ces engrais étaient le nitrate de soude, le superphosphate et le sulfate de potasse. Il a été constaté que les différences de saison ont grandement affecté le résultat. Le nitrate de soude appliqué à raison de 300 livres à l'acre a causé une augmentation significative de rendement en une saison relativement fraîche (1932), tandis qu'une quantité de 600 livres à l'acre entraînait une diminution de rendement en une saison sèche (1933 et 1934). Le superphosphate appliqué à raison de 750 livres à l'acre en 1932, et de 1,200 livres à l'acre en 1933 et 1934, n'a pas donné de résultats significatifs. Le sol sur lequel cet engrais a été appliqué était déjà bien pourvu de phosphore promptement assimilable. Le sulfate de potasse, appliqué à raison de 480 livres à l'acre en 1932-33-34, a donné des augmentations importantes de rendement en 1933 et 1934. Ici le sol était assez pauvre en potasse remplaçable. Le nitrate de soude, le superphosphate et le sulfate de potasse ne paraissent pas avoir exercé d'action l'un sur l'autre dans les différentes combinaisons.

NOTES

"Rural Taxation In Ontario" is the title of a new bulletin by S. C. Hudson, Economics Branch, Department of Agriculture, Ottawa. This bulletin is available upon request at the Publicity and Extension Branch.

A. E. Richards, Agricultural Economist, Economics Branch, Ottawa, in a radio talk broadcast from Cornell University, Ithaca, N.Y., on March 9th, made the following comment: "If co-operatives, whether in Canada or the United States, are going to hold their place in the commercial field, they must maintain a sound financial structure, hold a solvent position and withstand scrutiny and tests of business efficiency. Members of an association must realize that the co-operative is as much a part of their property and business as the orchard or the dairy herd and requires just as fair treatment and business-like handling."

Sir. A. D. Hall, in a paper to the Royal Society on Arts entitled "Can Agriculture Provide Substantial Relief for Unemployment?" said that the continued decrease in small holdings in the face of deliberate efforts to increase them was sufficient evidence that they no longer represented a form of occupation that would attract and retain men and it was a mistake to endeavour to put the clock back.

The Agricultural Branch of the Dominion Bureau of Statistics reports that during the first three months of 1936 production of cheese in Quebec increased 3.5%; in Ontario, the increase was 41.2%; in Alberta, 2.7%; while in British Columbia there was a decrease of 49.6%.

Production of butter during the first three months of this year increased by 9.3%. Each province contributed to the larger output. Prince Edward Island had an increase of 27.5%; British Columbia 48.6%; Manitoba 26.8%; Saskatchewan 24%; New Brunswick 17.9%; Alberta 2.2%; Ontario 2.0%; and Quebec 1.3%. Total production was 26,412,264 pounds compared with 24,162,546 pounds in the first three months of 1935.

Exports of beef cattle to the United States to April 8th totalled 45,035 head compared with 34,971 head in the same period of 1935. Exports of dairy cattle were 1,825 and 1,774 respectively, making a total export of cattle to the United States of 46,860 compared with 36,745 during this period in 1935. These data were supplied by the Live Stock Markets Intelligence Service of the Dominion Live Stock Branch.

The number of hogs graded during the first 15 weeks of 1936 was 911,952 compared with 938,156 during the same period of 1935. Sales of cattle at public stock yards were 207,385 head as against 191,373 head in this period of 1935. Sales of calves were 81,053 and 86,836 respectively, while sales of sheep were 47,614 compared with 56,412.

The Canadian Society of Agricultural Economics will hold its eighth annual meeting at the University of New Brunswick, July 13–16. The sessions will be held in conjunction with those of the parent organization, the Canadian Society of Technical Agriculturists.

The Bureau of Agricultural Economics, Washington, D.C., reported that on July 1, 1935, there were 237 research projects under way. Of this total 18 were in the Division of Agricultural Finance, 29 in the Division of Cotton Marketing, 12 in Dairy and Poultry products, 28 in Farm Management and Costs, 5 in Farm Population and Rural Life, 7 in Foreign Agricultural Service, 15 in Fruits and Vegetables, 13 in Grain, 8 in Hay, Feed, and Seed, 12 in Land Economics, 16 in Live Stock Meats and Wool, 4 in Marketing Research, and 51 in Statistical and Historical Research.

THE ECONOMIC ANNALIST

A REVIEW OF AGRICULTURAL BUSINESS PREPARED BI-MONTHLY BY THE AGRICULTURAL ECONOMICS BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA

Vol. VI, No. 2 April, 1936

THE ECONOMIC SITUATION

PREPARED IN THE AGRICULTURAL ECONOMICS BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA, LARGELY FROM BASIC DATA COLLECTED BY THE DOMINION BUREAU OF STATISTICS

There was little change in the index of wholesale prices in Canada during the first two months of this year. Vegetable product prices were slightly lower in February than in the previous two months. Animals and their products were unchanged in January but declined in February. Fibres, textiles and textile products also receded, and chemicals and allied products were fractionally lower: on the other hand, February indexes of wood, wood products and paper, non-ferrous metals and their products and iron and its products made small gains.

Retail Prices.—The index of retail prices reached 80.7 in January but receded to 80.4 in February. The index of retail prices of food declined one point and those of fuel and sundries advanced slightly. The rent and clothing indexes were not changed. The value of retail sales in February of this year at 69.1 was a little lower than in January but just the same as in February 1935.

Physical Volume of Business.—The index of the physical volume of business was 104.9 in February being more than one point below the index for December and fractionally lower than that for January. The index of industrial production declined to 104.9. Mineral production showed a substantial gain in February, the index rising to 186.2 compared with 144.4 in the previous month. Exports of nickel were considerably higher and shipments of both gold and silver were larger than during the month of January. Exports of asbestos and bauxite were also larger and coal production reached higher levels.

The index of manufacturing was little changed. Increased manufacture of cigars and cigarettes, larger exports of canned salmon, wood pulp, planks and boards largely offset declines in production of sugar, iron and steel, and construction. Distributive services showed some improvement. Agricultural marketings were higher in February, the movement of both grains and live stock being of larger volume. Among the grains, only flax marketings were of smaller volume. Shipments of calves were lower than in the previous month. Cold storage holdings showed a substantial increase, the index rising from 126.6 to 169.1. Holdings of eggs, cheese, beef and veal contributed largely to the increase in stocks on hand.

Prices of Agricultural Products.—The index of wholesale prices of Canadian farm products continues to rise slowly, the index for February being 66.0. The index of prices of field products showed a small recession; on the other hand, the index of prices of animals and their products was slightly above that for January; the total index was four points above that of February 1935.

The average price of No. 1 Manitoba Northern wheat, basis Fort William and Port Arthur, was 82.1 cents in February, compared with 84.8 cents in January. Prices of oats and barley were somewhat higher while prices of rye were slightly better and those of flax somewhat lower. The advance in prices of live stock was due to improvement in the monthly averages for hogs, calves and lambs. Prices of cattle were lower because of exceptionally heavy deliveries. Prices of eggs stiffened because of reduced supplies.

ANNUAL AND MONTHLY INDEX NUMBERS OF PRICES AND PRODUCTION
COMPUTED BY DOMINION BUREAU OF STATISTICS

Year	Wholesale Prices 1926 = 100				Retail prices and cost of services (5)	Production (6) 1926 = 100			
	All commodities (1)	Farm products (2)	Field products (3)	Animal products (4)		Physical volume of business	Industrial production	Agricultural marketings	Cold Storage holdings
1913	64.0	62.6	56.4	77.0	65.4				
1914	65.5	69.2	64.9	79.0	66.0				
1915	70.4	77.7	76.9	79.2	67.3				
1916	84.3	89.7	88.4	92.3	72.5				
1917	114.3	130.0	134.3	119.6	85.6				
1918	127.4	132.9	132.0	134.7	97.4				
1919	134.0	145.5	142.4	152.5	107.2	71.3	65.5	48.1	47.1
1920	155.9	161.6	166.5	149.9	124.2	75.0	69.9	52.6	94.2
1921	110.0	102.8	100.3	108.5	109.2	66.5	60.4	65.2	86.4
1922	97.3	86.7	81.3	99.1	100.0	79.1	76.9	82.6	82.8
1923	98.0	79.8	73.3	95.1	100.0	85.5	83.8	91.4	87.6
1924	99.4	87.0	82.6	97.2	98.0	84.6	82.4	102.5	114.9
1925	102.6	100.4	98.1	105.7	99.3	90.9	89.7	97.2	108.6
1926	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1927	97.7	102.1	99.9	105.7	98.4	106.1	105.6	103.6	110.0
1928	96.4	100.7	92.6	114.3	98.9	117.3	117.8	146.7	112.8
1929	95.6	100.8	93.8	112.5	99.9	125.5	127.4	101.1	109.6
1930	86.6	82.3	70.0	102.9	99.2	109.5	108.0	103.0	128.4
1931	72.2	56.3	43.6	77.6	89.6	93.5	90.4	99.0	125.7
1932	66.7	48.4	41.1	60.7	81.4	78.7	74.0	114.3	120.1
1933	67.1	51.0	45.8	59.7	77.7	79.7	76.8	105.1	115.4
1934	71.6	59.0	53.8	67.7	78.9	94.2	93.6	88.5	114.2
1935	72.1	63 4	57.1	73.9	79.3	102.4	103.3	87.4	128.4
1935									
Jan.	71.5	61.4	55.7	71.0	78.8	97.5	97.8	30.6	143.7
Feb.	71.9	62.0	55.7	72.6	78.9	100.6	101.1	62.2	141.2
Mar.	72.0	62.7	56.4	73.3	78.8	94.2	93.3	65.4	143.2
Apr.	72.5	64.7	59.8	72.9	78.6	98.3	97.7	91.8	135.8
May	72.3	64.1	58.0	74.4	78.6	103.2	104.4	86.3	123.2
June	71.5	61.4	55.1	72.0	78.8	99.2	99.7	106.1	125.0
July	71.5	61.5	55.7	71.1	78.8	103.0	104.0	164.7	114.8
Aug.	71.6	61.8	55.5	72.4	79.4	107.9	110.3	163.9	117.0
Sept.	72.3	64 7	58.3	76.5	79.6	101.9	102.5	114.2	117 2
Oct.	73.1	65.8	59.3	76.7	80.4	107.2	109.5	86.6	119.7
Nov.	72.7	65.0	57.8	77.1	80.6	110.0	113.5	43.3	127.1
Dec.	72.6	65.4	57.9	77.9	80.6	106.2	108.8	34.0	133.4
1936									
Jan.	72.9	65.9	59.0	77.5	80.7	105.2	107.0	39.8	143.4
Feb.	72.5	66.0	58.9	77.8	80.4	104.9	104.9	62.7	153.3

1. See Prices and Price Indexes 1913-1928, pp. 19-21, 270-289 and 1913-1934, p. 15.
2. Wholesale prices of Canadian products of farm origin only. See Prices and Price Indexes 1913-1934, p 52, and Monthly Mimeographs 1934 and 1935.
3. Wholesale prices of grains, fruits and vegetables.
4. Wholesale prices of Animals and Animal Products.
5. Including foods, rents, fuel, clothing and sundries. See Prices and Price Indexes 1913-1928, pp. 181-185, 290-293. 1926 = 100.
Prices and Price Indexes 1913-1934, p. 117, and Monthly Mimeographs, 1934-1935.
6. Monthly Review of Business Statistics, p. 8, and Monthly Indexes of the Physical Volume of Business in Canada, supplement to the Monthly Review of Business Statistics, November, 1932.

The European winter wheat acreage is somewhat lower than in 1934–35 and present indications are that the high yields which characterized recent crops may not occur this year. Prospects in the United States are rather better than in 1934–35.

Broomhall's record of world shipments from August 1, 1935 to March 14, 1936, was 313.5 million bushels compared with 326.5 during the same period of 1934–35 With the large reduction in the Argentine crop of 1935–36, the world supply of wheat

has shifted. During the first 10 weeks of the calendar year of 1935, the Argentine shipped 40.5 million bushels, Australia 26.3 millions, Canada 23.1 millions and "Other Countries" 9.3 millions. During the first 10 weeks of 1936, Argentina shipped 10.8 millions, Canada 47.0 millions, Australia 34.0 millions, and "Other Countries" 14.8 millions, according to the Agricultural Branch of the Dominion Bureau of Statistics. It is reported too that on March 13, Canada's surplus for export or carryover was 244 million bushels compared with 272 millions a year ago. Increased competition from the U.S.S.R. and United States in 1936–37 appears probable although the policy of the United States' government respecting exports is not yet clear. The extent of Argentine competition may be influenced by governmental policy respecting the minimum price to be paid for Argentine wheat. Present prospects would indicate that Canada may continue to be the chief source of world supply until the end of 1936. An encouraging feature of the present crop movement is the fact that during February 1936, Canada supplied 50.8% of the total imports into the United Kingdom as against 29.3% in February 1935.

Export Trade.—For the twelve months ending February 1936, exports of apples were 2,412,240 barrels valued at $11,857,163, compared with 2,108,163 barrels valued at $10,511,024 during the twelve months ending February 1935. Canned vegetables exported amounted to 38,479,769 pounds and 21,238,184 pounds respectively, and the values were $1,612,950 in 1936 and $1,019,204 in 1935. During the same period 1,203.655 cwts. of bacon and hams were exported whereas during the twelve months ending February 1935, 1,301,239 cwts. were exported; the respective values were $19,344,573 and $20,693,410. Exports of cheese were 56,459,000 pounds valued at $6,574,765 during the period ending February 1936, compared with 60,294,000 pounds exported during a similar period ending February 1935 which were valued at $6,491,146.

TERMINAL MARKETS[1]

W. C. Hopper[2]

Sufficient space is another important consideration. Terminal markets are built for many years to come, and in so far as is possible provision should be made for twenty or more years hence. It should be remembered that when a successful market is established, the adjoining land will become greatly enhanced in value, and if, in time, the original area devoted to the market becomes too small to efficiently handle the produce brought to it, the purchase of more land may prove a very expensive undertaking. For a joint terminal market in Toronto, for example, fifteen or more acres would appear to be necessary.

As rail connections for the stores of the wholesaler, jobber and commission merchants which are located close to the farmer and trucker terminal are essential features of a modern terminal market, the site selected must provide such facilities.

Other considerations to which attention must be directed in locating the market include:

1. The site should be accessible to the majority of the farmers and truckers who bring produce from the producing areas.
2. It should be at a point where the producer traffic and all other vehicular traffic incident to the market interferes least with the other traffic of the city.
3. The location should be such that rail traffic in perishable produce interferes least with other rail traffic of the city.
4. The site should provide suitable location for other lines of trade closely allied with the produce trade.
5. It should be possible to expand the market to the greatest extent without breaking up the plan for its general layout.

[1] The first section of this article appeared in the February issue of the Economic Annalist.
[2] Chief, Division of Marketing, Economics Branch, Dept. of Agriculture, Ottawa.

6. The market should be of easy access to buyers who come to it in motor trucks and automobiles and be situated where ample parking facilities may be obtained.
7. The location of the market should be such as to interfere the least with the present residential zones.

It is seldom possible to find a site where all the desirable features set forth above are available. A city having such a site is most fortunate and the opportunity to acquire it should not be lost.

Because of its relation to the efficient operation of a market, market layout stands second in importance to a proper site.

Market Layout.—The results to be obtained in an ideal market layout are minimum handling costs, equalization of the value of market stalls and stores as sales space, efficient use of space, and convenience in the transfer of produce from the sellers' to the buyers' vehicles.

Minimum handling costs and convenience in the transfer of produce are attained by providing space on the market sufficient to enable the buyer to park his truck near those from whom he buys and by the use of a site the shape of which would permit of the orderly concentration of business around a central point. There are many details with respect to market layout which must be considered, but these details will not be discussed at this time.

Financing, Operation and Administration.—Before a new market can be created, funds must be provided from one source or another. The sites for many existing public markets have been given by the cities in which they are located. As markets in our larger cities have grown up from city to regional, provincial or even national markets, the city cannot be expected to bear the entire costs of the construction, operation and management of new wholesale terminal markets. Some of the newer markets in the United States have been erected with funds borrowed by farmers' co-operative associations from the Federal Treasury, to be paid back over a long period of time. In other cases the railroads have furnished the site and financed the construction of the new terminal, leasing the space for the sale of produce by growers and truckers to a Growers' Co-operative for a period of years.

In New York State, the terminal markets at Syracuse and Newburgh are being constructed by corporations created by the State Legislature, which are called Regional Market Authorities. These corporations were created for the purpose of building and operating the public markets within a Regional Market District. The Regional Market District in the case of the Syracuse area is composed of six counties in which is produced the major portion of the produce sold on the farmer and trucker section of the Syracuse market. The Board of Directors of the Regional Market Authority is composed of thirteen members. The Commissioner of Agriculture for New York State is a member ex-officio, and the six Boards of Supervisors (County Councils) of the counties of the regional market district appoint two members each to the Board of Directors, one of whom shall be actually engaged in farming and deriving the greater part of his income therefrom.

The Authority may acquire, lease, construct and operate market facilities within the district. It may execute contracts, bonds and other securities and sell or dispose of the same. It may borrow money from Federal or other agencies. It may employ managers and may fix and collect rentals and market fees.

In the case of the primary markets now under construction at Syracuse and Newburgh and the secondary market at Poughkeepsie, funds have been loaned by the Federal and State Governments for the projects, to be repaid over a long term of years from revenues collected through market fees and rentals.

Professor M. P. Rasmussen of Cornell University calls attention in a recent address to another possible source of funds for the construction of markets in the United States. He says, "Much attention is being paid at present to the erection of public works in an effort to relieve unemployment. Presumably, such public works

should be of direct benefit to as large a proportion of the population as possible. Most of our large terminal markets serve very wide areas . . . . . The building of efficient food terminals in our cities through the elimination of congestion, spoilage, waste, re-handling and high cartage costs might reasonably be expected to benefit many millions of consumers dependent on such markets."

Market revenues include rents which wholesalers, jobbers and commission merchants who require stores will pay, and the annual seasonal and daily fees which will be paid by the growers and truckers and possibly some buyers for their stalls. At the new Albany market which is operated by a farmers' co-operative, the annual fees for leasing reserved market space are as follows:

Farmers	$ 36.00 per year.
Farmer-dealers	100.00 per year.
Trucker-dealers (minimum)	250.00 per year.
Inter-city truckers	25.00 per year.
Hucksters	150.00 per year.
Local retailers	5.00 per year.
City peddlers	5.00 per year.

The fee for leasing unreserved space by the day is as follows:—

Farmers	$ .50 per day.
Farmer-dealers	2.00 per day.
Trucker-dealers (minimum)	5.00 per day.
Hucksters	3.00 per day.

At the Syracuse market, which is now operated as a city market but which will be under a Regional Market Authority when the new market in this city is created, the fees are as follows:

	Producers	Dealers
12 months	$60.00	$120.00
6 months	40.00	80.00
3 months	30.00	60.00
1 day	.40	1.00

It is argued that the fees of the trucker or trucker-dealer, who is really "a jobber on wheels", must be placed at a higher level than the fees of growers, because truckers usually handle much larger loads, they usually come to the market on market days the year round more regularly than producers, and they have no other investment but their motor trucks. Another argument which has been advanced for charging the trucker more than the farmer is that he is rather difficult to control and is liable to bring in supplies purchased at bargain prices at some distant point which enables him to dominate the market on any particular commodity for the day. The farmers, on the other hand, must finance their farms as well as their marketing, and the resident jobbers and commission merchants with whom the truckers also compete must pay rent, light, heat and other expenses involved in operating a store.

It has already been pointed out that there are different controlling bodies which may administer wholesale terminal markets, namely, the city in which the market is located, the Regional Market Authority, the farmers' co-operative or the railroad which has built the market. As the use and value of wholesale terminal markets of to-day are no longer confined to the city at or near which the market is located, it would appear that the exclusive control and management should no longer be vested in the city. As wholesalers, jobbers, commission merchants, growers and truckers are all vitally interested in such a market as well as the city consumers and out of town buyers, it would appear desirable that all the interests concerned, or at least the major part of them, should be represented in the body administering the market. If funds are obtained from the provincial or the federal government, advisory government representatives might also be desirable.

It is doubtful if any new market has ever been created without objections from some individual or group of individuals. In many cases these objections may appear at first to be quite legitimate but when the true facts of the whole situation are revealed, the opposition often becomes dissipated to a large degree. If it can be clearly shown that the erection of a new market will work an undue hardship on some group of sellers or buyers every consideration must be given to the alleviation of this injury, still keeping in mind the benefit that will accrue by the new project to the majority concerned.

FARM LABOUR IN CARLETON AND VICTORIA COUNTIES, NEW BRUNSWICK

IAN MCARTHUR[1]

The question of farm labour and its cost has been receiving more attention in recent years, as farmers and research workers in agricultural economics have been endeavouring to find ways and means of reducing farm costs. In the analysis of the data secured in the farm management survey conducted in the counties of Carleton and Victoria, New Brunswick, during the summer of 1935, some interesting facts have been brought out concerning the supply and cost of farm labour. The major cash crop of the area is potatoes. Farmers devote approximately one-third of their time to the production of this crop. The division of labour on these farms, according to enterprises is indicated by Table 1.

TABLE 1.—THE DIVISION OF LABOUR ON BASIS OF PRODUCTIVE MAN WORK UNITS, CARLETON AND VICTORIA COUNTIES, NEW BRUNSWICK, CROP YEAR, 1934–35

Enterprise	Productive-man-work-units	Per cent of total
Potatoes	144.7	33.5
Other crops	143.8	33.3
Live stock	122.0	28.2
Outside labour	21.7	5.0
Total	432.2	100.0

The term "productive-man-work-unit" is used to represent the number of ten hour days of man labour required per head of productive live stock and per acre of crops. In the case of the potato crop, the days of labour required were secured in detail from the farmers. Productive-man-work-units necessary in connection with the production of other crops, live stock and outside labour were estimated by use of a standard designed to suit farming conditions in New Brunswick.

The total figure for productive man work units shown in Table 1, indicates that on the average 432.2 days of labour were required to operate the average farm included in the study. Assuming that there are approximately 300 working days in a year, it would have required one man, working full time and a helper, working about three months, to supply the labour requirements of these farms. This figure would approach the maximum efficiency in the use of labour and would require the farmer and his helper to be working practically every working day.

In view of the seasonal nature of much of the labour required on farms, especially where there is such a degree of specialization in the production of one crop as is the case on these New Brunswick farms, it is to be expected that the actual amount of labour utilized would exceed the amount necessary to handle the work on the basis of productive-man-work-units.

The average amount of family labour and hired labour available on the farms included in the study totalled 27.2 months per farm, or the equivalent of two men working full time and one man working 3.2 months of the year. The months of available labour were made up of 11.7 months of the operator's labour; 9.0 months of family labour, and 6.5 months of hired labour per farm. A summary of the

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amounts of labour available, the rates of wages paid to hired labour and the estimated valuation of unpaid labour is shown in Table 2.

TABLE 2.—SUMMARY OF PAID AND UNPAID LABOUR, RATES OF WAGES AND TOTAL COST PER FARM ON 199 FARMS, CARLETON AND VICTORIA COUNTIES, NEW BRUNSWICK, 1934–35

Item	No. of farms with this item	Total M'ths. of labour per farm	Average monthly wage	Total cost per farm of labour
			$	$
Paid labour				
Year help	27	1.6	22.06	35.92
Month help	97	3.3	22.58	73.76
Day help	180	1.6	44.60	71.49
Total paid	191	6.5	27.88	181.17
Board, paid labour	191	6.5	8.89	57.78
Total cash outlay	191	6.5	36.77	238.95
Unpaid labour				
Operator	199	11.7*	35.00	410.85
Operator's family	122	9.0	21.33	192.69
Total unpaid	199	20.7	29.06	603.54
TOTAL PAID AND UNPAID LABOUR	199	27.2	30.97	842.49

* Eleven operators did not work full time on their farms.

Types of Labour.—Labour was hired by all but 8 of the 199 farmers included in the survey. Day labour hired during the rush season of seeding, haying and potato digging was the most frequent type of labour hired. This class of labour was reported on 180 of the farms. Only 27 farmers kept a hired man for the entire year and 97 farmers hired men by the month during the summer season.

The average monthly wage of a man hired by the year was $22.06. Men hired by the month received an average wage of $22.58 per month. Day labourers were paid an average of $1.72 per day, or $44.60 per month. This rate is somewhat above the prevailing rate for day help, chiefly because men hired for digging and picking potatoes are usually paid on a piece-work basis, rather than by the day. The average wage paid to all farm labourers was $27.88. A charge was made for the board of paid labourers living on the farm. This charge for board averaged $8.99 per month, bringing the total cash outlay for labour and board up to $36.77 per month.

All of the farm operators worked at least part of the time on their Mwn farms However, eleven of these men had other regular occupations, such as game wardens, drovers and salesmen. Unpaid family labour was available on 122 of the 199 farms. Operators estimated their time to be work an average of $35.00 per month. This average rate was used for all farm operations. The average value paid on unpaid family labour was $21.33 per month.

The total cost of hired labour on a per farm basis including board was $238.95. When the value of the unpaid labour of the operators and that of their families was added

TABLE 3.—PERCENTAGES OF HIRED LABOUR, FAMILY LABOUR AND OPERATOR'S LABOUR ON THE BASES OF TIME AND VALUE, CARLETON AND VICTORIA COUNTIES, NEW BRUNSWICK, SURVEY 1934–1935

Type	Per cent of time	Per cent of cost
Hired	23.8	28.4
Family	33.3	22.9
Operator	43.1	48.7
All farms	100%	100%

to the value of paid labour, the total cost of all labour and board amounted to $842.49 per farm.

On the basis of time 23.8% of the labour was hired; 33.1% was provided by members of the family other than the operator and 43.1% was the work of the operator himself. The cost of hired labour per month was slightly higher than the allowance made for the operator's time and considerably above the estimated value of family labour. On the basis of labour costs, the percentages provided by each type of labour was somewhat different, due to the difference in values of the various types of labour.

Labour on Potato Crop.—Labour requirements for the growing, harvesting and storing of the potato crop in 1934 averaged 93.3 hours per acre. The greater part of this time was devoted to the growing of this crop. Ploughing required 6.9 hours per acre. Farmers ploughed an average of approximately one and one-half acres of land per day. The land was disked on only a few of the farms, but harrowing was practised in most cases. Considerable time was devoted to picking stones off the potato land. Almost all of the soil of the area tended to be stoney, although some of the farms had been quite thoroughly picked in the past.

TABLE 4.—MAN AND HORSE LABOUR REQUIREMENTS OF POTATOES PER ACRE ON 199 FARMS, CARLETON AND VICTORIA COUNTIES, NEW BRUNSWICK, 1934–35 CROP YEAR

Item	Man labour hours	Horse labour hours
Manuring	4.2	5.4
Ploughing	6.9	14.2
Disking	0.5	0.8
Harrowing	3.0	6.0
Picking stones	3.4	3.9
Hauling fertilizer	1.7	3.2
Mixing fertilizer	1.6	—
Seed preparation	7.0	—
Applying fertilizer	0.2	0.2
Hand planting	0.3	—
Machine planting	4.5	5.9
Horsehoeing	6.8	13.3
Weeding	2.1	—
Cultivating	7.2	14.2
Rogueing	1.1	—
Repairing equipment	2.0	—
Mixing spray and dust	0.2	—
Spraying	5.0	8.1
Dusting	0.1	0.6
Total growing	57.8	75.8
Hand picking	21.2	—
Machine digging (horse)	6.1	12.3
Machine digging (tractor)	0.3	—
Cleaning up field	1.5	1.7
Total harvesting	29.1	14.0
Hauling to farm storage	4.9	8.7
Hauling to hired storage	0.7	1.2
Labour in storage	0.8	—
Total storage	6.4	9.9
TOTAL LABOUR	93.3	99.7

Fertilizer was generally hauled to the farms by the farmers themselves and in many cases the individual ingredients were mixed on the farms. Commercial fertilizer was generally applied at the same time as the seed was planted. Cutting seed required an average of about 1 hour of labour per barrel. There was a wide variation in the amount of seed cut per day, but from 8 to 10 barrels was considered a good day's work. Planting was done by machine in almost all cases.

Horsehoeing and cultivating were the most important cultivation practices after the crop was planted. The number of times these operations were repeated depended upon weather conditions and the condition of the soil. Spraying was usually repeated at least four times. Those who grew seed for certification devoted some time to rogueing the crop. Picking of the crop at harvest time required the greatest amount of man labour and this work was generally done by hired labourers, although in some cases sufficient family help was available to handle the job. Digging was done almost entirely by machine. A final day was usually devoted to cleaning up the field and burning the stubble.

Labour and Size of Business.—The amount of labour utilized in producing an acre of potatoes did not vary a great deal as the size of business increased, but the rate charged per hour was lower on the larger farms because of the fuller use to which labour was put on these farms. As a result of the reduction in the rate charged, the labour cost per acre of potatoes was lower on the larger farms.

TABLE 5.—RELATION OF SIZE OF BUSINESS TO LABOUR COSTS IN THE PRODUCTION OF POTATOES

Productive-man-work-units	Acres of potatoes	Hours per acre	Rate per hour	Labour charge per acre
			¢	$
0 – 300	8.5	94.0	24.1	22.65
301 – 400	10.2	92.6	21.6	20.00
401 – 500	15.5	91.6	18.9	17.31
501+	19.6	95.2	18.4	17.52
All farms	13.8	93.3	19.8	18.47

The type of labour also changed with the size of the farm business. The percentage of work done by the farm operator himself became lower and consequently the percentage of hired labour became higher. Changes in the percentages of the various types of labour used on a time basis is shown in Table 3.

TABLE 6.—RELATION OF SIZE OF BUSINESS TO THE TYPE OF LABOUR USED ON 199 FARMS, CARLETON AND VICTORIA COUNTIES, N.B., SURVEY 1934–35

Productive-man-work-units	Per cent of hired labour	Per cent of family labour	Per cent of operator's labour
0 – 300	13.8	23.7	62.5
301 – 400	15.9	36.2	47.9
401 – 500	25.9	32.5	41.6
501+	31.8	34.8	33.4
All farms	23.8	33.1	43.1

CO-OPERATIVE SHIPMENTS OF LIVE STOCK IN NOVA SCOTIA 1935

——	Number	Value	Average
		$	$
Lambs	8,032	34,914.62	4.10[1]
Hogs	476	8,449.29	17.75
Calves	33	153.59	4.65
Cattle	120	2,074.07	17.28
		45,591.57	

Thirty local shipping clubs in Nova Scotia were active during 1935. Shipments were smaller than in 1934. The larger decrease was in number of cattle shipped which dropped from the unusually high figure of 1,002 in 1934—a year of drought—to 120 in 1935. The average return per head was higher in 1935. These increases amounted to $9.29 per head for cattle, $3.03 per head for hogs and 74 cents per head for lambs. Shipment was made through the Canadian Livestock Co-operative (Maritimes) Ltd., and fertilizer was also handled through this organization.

[1] Average value of lambs is exclusive of shipments of ewes to Newfoundland.

FIFTEEN YEARS OF BARLEY PRICES[1]

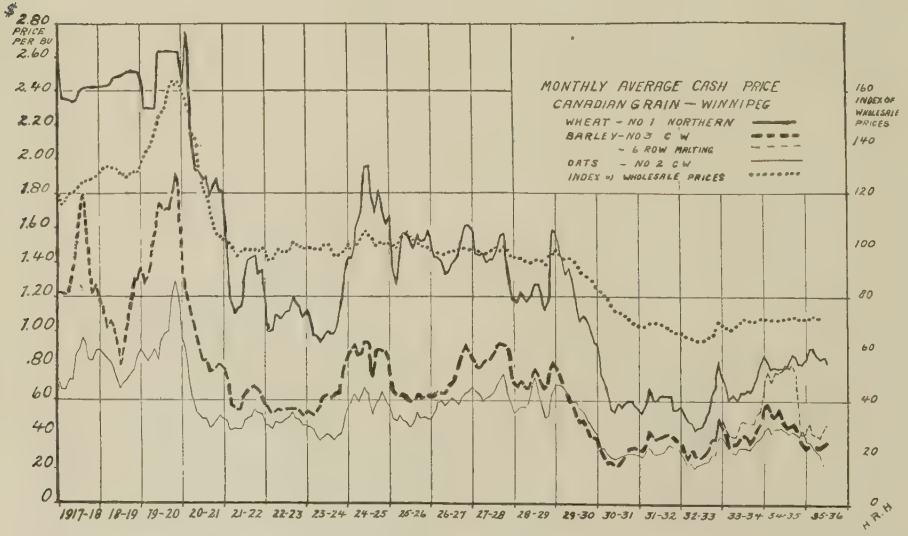
H. R. HARE[2]

Commodity price changes during the past 15 years have been so violent and rapid that many students have found difficulty in keeping pace with the fluctuations. The dips and rises which have occurred in connection with barley and other related commodity prices have been no less difficult to follow. The graphs and charts which accompany this article are the writer's modest attempt to summarize fifteen years of Canadian cereal price and production history and to show in part the effect on certain phases of the live industry.

Figure 1 pictures the average monthly cash prices of No. 3 C. W. barley, No. 1 Northern wheat and No. 2 C. W. oats at Winnipeg from 1917 to the present, and for the past two and one-half years it shows the price of six-row malting barley. The peak price of No. 3 C. W. barley occurred in June 1920 when the monthly average price was set at $1.92 per bushel. The lowest point was recorded in October 1932 for which month the average price was 25.8 cents. The high point of oat prices was reached at the same time as barley and wheat just three months later. The high points attained by No. 1 Northern wheat and No. 2 C. W. oats were $2.77 and $1.29 per bushel respectively.

In studying the prices as recorded in the chart, it will be noted that the prices of various grains tend to move up and down simultaneously but they do not retain at all times the same relationship one to the other. Changes in the comparative supply or demand factors account for the great bulk of the apparent irregularities. This is shown very clearly as pertaining to both qualities of barley recorded in the chart. During 1934 and 1935 there was a short and low quality crop of barley produced in the United States and barley of malting quality was exceedingly scarce. Canada's barley crop had also been low. While barley of malting quality generally yields a price premium over 3 C. W. barley of from 3 to 7 cents per bushel, it is recorded during 1934 and 1935 that malting barley at Winnipeg commanded a premium at one point during that period of 25 cents per bushel over 3 C. W. barley. The handsome premium paid for malting barley over 3 C. W. at this point was caused by the relative

CHART NO. 1

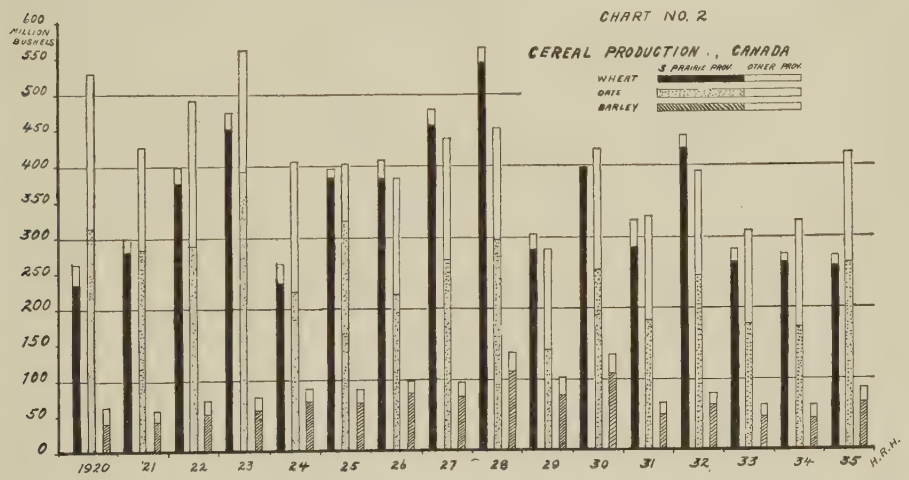


[1] Paper presented at The National Barley Committee Meeting, Toronto, March 11, 1936.
[2] Assistant Economist, Economics Branch, Ottawa.

supply and demand situation. Again the chart shows that the price of No. 3 C. W. barley was lower than that of No. 2 C. W. oats in 1929 and 1930 and again in 1935. Similar conditions obtain for the other cereals and to grades within these cereals.

The slump of 1921 and continued low price period of 1922 and 1923 were followed by comparatively high prices from 1924 to 1930. Prices dropped to an unprecedented low during 1931 and 1932. The price of wheat has gradually risen from then to the present, as also did prices of barley and oats until September 1934. Since that time, barley and oat prices have tended to move downward and in inverse direction to that of wheat.

The explanation of these facts is that Canadian wheat and coarse grains are consigned to different markets and reflect the supply and demand situations in these different markets. Canadian wheat prices are affected very largely by world wheat prices while domestic conditions regulate prices for coarse grains. The world wheat surpluses have been gradually disappearing and this no doubt has been a factor resulting in higher wheat prices with a certain degree of stability The coarse grains market is influenced largely by the Canadian demand for feed. During the last few years, the prices of live stock and live stock products have been low and the purchasing power of live stock farmers has been restricted. Hog numbers have decreased considerably. Many farmers have fed less and consequently the demand for feed grains has gone down, carrying coarse grain prices with it. During the depression, farmers in live stock areas have been forced to feed such grain as they grew and have purchased little to supplement home grown feed. Thus, it is that we have experienced a gradual widening of the prices of wheat and coarse grains.

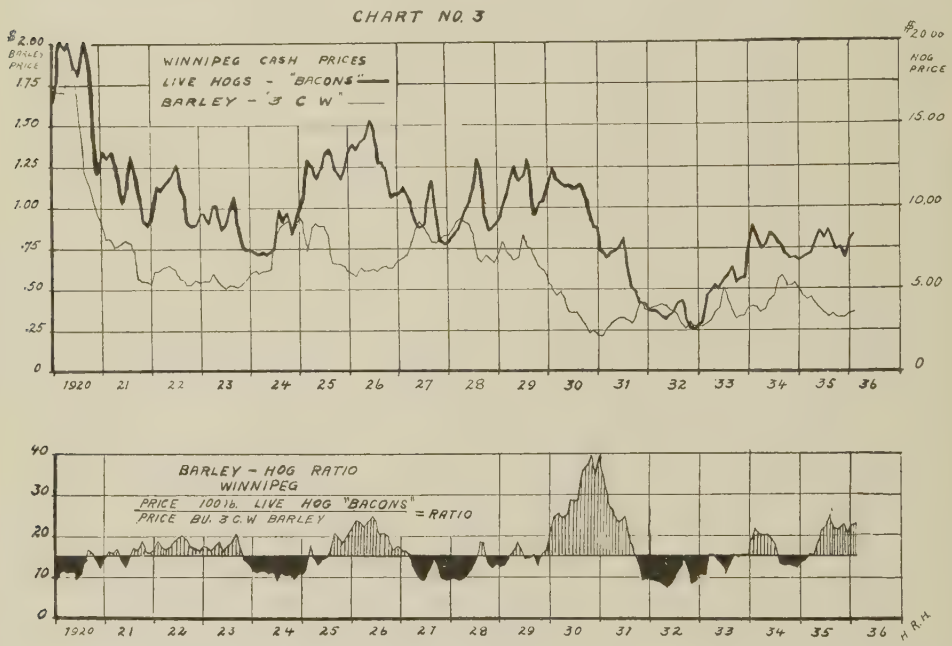


The index of wholesale prices has been charted on Figure 1 and is so based as to correspond with the average wheat price of 1926. It will be noted that there is a tendency for cereal prices to follow the index of wholesale prices, but during the 1921 depression and since 1930 cereal prices have been much lower than wholesale prices. A study of the graph gives reason to expect that cereal prices will rise to a point above that now prevailing, but world crop conditions and purchasing power may move in such directions as to offset any predictions.

Figure 2 is presented to show the great variation in the cereal supply from year to year in Canada since 1920. This chart depicts Canadian yields of wheat, oats and barley for each year. It may be noted that in 1933 and 1934, the total cereal yields were among the lowest cereal production years shown on the chart. Yields of wheat and oats have varied greatly, and barley yields, though small compared to wheat and oats, were in 1933 and 1934 about half those obtained in crop year of 1930.

As coarse grain prices are dependent on the live stock situation in Canada, and as those interested in marketing Canadian live stock products are attempting to regulate the volume of live stock which comes to market, it would appear to be good practice to exert every effort to smooth out annual fluctuations of yields in so far as possible. Further, as barley in every province of Canada yields a greater number of feed units per acre than other cereals, it would appear to be good economics for Canada to increase the proportion of barley sown on Canadian farms.

The solid section of each bar of Figure 2 depicts that portion of the Canadian crop grown in the three Prairie Provinces, while the balance of the bar represents that portion of the Canadian crop produced in all other provinces. From a study of this graph, one is impressed with the overwhelming proportion of the Canadian wheat crop grown on the Prairies. Wheat production in other provinces is comparatively small. The out-turn of oats is much more evenly distributed over Canada than wheat. Much the greater proportion of the Canadian barley crop is produced on the Prairies but the proportion is not so great as in the case of wheat.



The close relationship of coarse grain prices and conditions in the Canadian live stock industry has prompted the writer to prepare Figure 3. We recognize that in the corn belt of the United States in which hog production has attained great intensity —where some individual farmers produce as many hogs as do the farmers of many whole counties in Ontario—that the corn-hog ratio is followed very closely. In the top section of Figure 3, the Winnipeg market prices of 3 C.W. barley on a bushel basis and live hogs on the hundredweight basis have been presented. The barley price scale, shown on the left is just 1/10 of that of the hog price scale shown on the right. The average monthly price of live hogs for the 16 year period 1920-1935 was $9.72 per hundredweight and for barley 63.4 cents per bushel. On this basis, it took on the average 15.3 bushels of barley to equal the price of one hundred pounds of live hogs. On the lower section of Figure 3, the ratio of these prices is plotted. This ratio is secured by dividing the monthly average price of one hundred pounds of live hogs by the monthly average price of one bushel of barley. The two sections shown on Figure 3 represent similar periods of time and it will be noted that when the barley

price lines and hog price lines converge that the ratio line appears below the base line of the lower graph, and when the price lines of the upper section are widely separated that the ratio appears positive to the base line, as shown in the lower section. Briefly, it may be stated that as it took on an average for the whole period 15.3 bushels of barley to equal the price of one hundred pounds of live hogs, that the profitable periods in hog production were those periods when the price of a greater number than 15.3 bushels of barley were required to equal the price of one hundred pounds of live hog These periods are shown above the base line in the lower section of the chart. One may note that these periods have appeared as cycles, with a certain degree of uniformity, 2–3 years profitable periods followed by 2-3 of unprofitable prices. A cursory study of the chart would indicate that while the ratio between barley and hogs at Winnipeg at the moment is favourable to hog production, the favorable ratio has continued for such length of time that we are due at any time to move to a less profitable point for hog producers.

During the past few years, however, such changes have been effected in normal marketing procedure through regulation of the marketing of hogs in Britain that one cannot use historical data to predict with precision market situations which are influenced by new factors. At the moment, the barley-hog ratio is favourable to the hog producer, and those who have hogs to finish say within five to six months should do well with them.

While barley is recognized as one of the best feeds for hogs, one finds that in Canada that hog producers do not hold to barley as closely as the United States hog producers hold to corn. For this reason, the barley-hog ratio has not come into such frequent use in Canada as has the corn-hog ratio in the United States. To those farmers who are buying feed, the barley-hog ratio is of greatest significance.

REDUCING THE COSTS OF TRANSPORTING MILK

"The greatest opportunity for effecting savings and bringing about economic stability in transportation of milk lies in reducing the mileage that milk is haulded and in increasing the volume per load" is a statement contained in a paper presented by Dr. R. W. Bartlett of the University of Illinois at the last annual meeting of the American Farm Economic Association. Dr. Bartlett goes on to show how these savings may be accomplished by citing the experience of the producers' association in Dayton, Ohio. This association commenced a re-routing program in the spring of 1930 and completed it in the early part of 1931. The results of this program were summed up in a paper entitled "The Co-operative Control of Hauling" which was presented at the annual meeting of the National Co-operative Milk Producers' Federation by Mr. C. W. Lawrence, the general manager.

"After the northern section had been re-routed in the fall of 1930, the southwest and east sections of our milkshed were re-routed, making the re-routing program complete. The total of 17 trucks (out of a total of about 47) were eliminated, and the hauling rate was reduced on an average of almost ten cents per hundred pounds, which meant a saving of over $50,000 to the farmers the very first year that this re-routing was accomplished."

A careful analysis was made of a selected area in the Dayton milkshed to determine what was done to obtain lower hauling costs. The results of the re-routeing program in this selected area were the elimination of five of the fourteen routes hauling milk for 506 producers in this area; the round-trip mileage was reduced from 847 to 526 miles or a net reduction in mileage of 38%; the average volume per truck was increased from 1,835 pounds to 2,855 pounds per day or a net increase of 56%; the average hauling rate paid by producers was reduced from 40 to 30 cents per 100 pounds or a net reduction of 25%; the average income per truck was increased from $6.81 to $7.74 per day or a net increase of 14%. With fewer routes, milk was delivered to distributors' plants one hour earlier than formerly. This helped producers to deliver milk in better condition, particularly during the summer months.

"Reasonable returns to truckers are necessary in any long-time economic program. Not infrequently, the practice of bidding for routes has resulted in a trucker accepting a hauling rate lower than his actual labour and operating costs. Such a trucker is bound to be both a discontented and disturbing influence in the market. It is a much better business practice to reduce mileages and arrange routes so that a full load can be hauled and then pay the trucker actual operating costs plus a reasonable return for labour."

"The re-routing program was accomplished in the following ways: In the first place, at the request of producers in a given area, a careful study was made by the association of existing conditions, and hauling routes were mapped and rearranged on an economic basis. A series of meetings were then held in the local area, at which maps were shown and discussed until the producers became thoroughly familiar with the proposed changes. Following this, the association with the assistance of a local committee made arrangements for eliminating certain routes in spite of the many objections from the truckers. Frequently a trucker was paid a given sum for giving up his route and agreeing not to truck milk for a five-year period. Producers benefiting by the elimination of the route paid for this with savings effected—usually within a period of six months. All negotiations were made by the association at the request of local member groups. Centralized authority in the re-routing program was essential to its success."

AGRICULTURAL OUTLOOK SERVICE

The Agricultural Outlook Service in Canada has been a development of the past four years. In 1932 the Department of Farm Management, University of Saskatchewan, published the first issue of the Farm Outlook for Saskatchewan. Almost simultaneously the Agricultural Outlook for Nova Scotia appeared. "The Agricultural Situation" was published by the Departments of Agriculture and Trade and Commerce of the Dominion Government in January, 1934. The following year the Title was changed to "The Agricultural Situation and Outlook". These reports have continued to serve large numbers of readers in their respective spheres, and in March of this year the Ontario Agricultural Outlook Report was presented for the first time. Thus, in the space of four years, three provinces, as well as the Dominion Government, have made an annual appraisal of the outlook for Agriculture.

These reports do not represent a duplication of effort, each having its own place. The report published by the Dominion presents an analysis from the national point of view, whereas the provincial reports enable the amplification of certain lines of production in which the province in question may be especially interested. It is recognized, of course, that additional extension work will be necessary before the maximum benefit will accrue from such activities but there has been substantial recognition of the place of Outlook reports in adjusting production to current demand. Evidence of the growing appreciation of such work may be found in the following editorial which appeared in the Winnipeg Newspaper Union "Mirror".

"At this time of the year farm owners, farm operators and others interested in agricultural production are necessarily giving a great deal of thought and attention to the all-important problem of what to raise and how much to produce during the 1936 season.

Time was when this problem, if it was a problem at all, was comparatively a simple one. All that was necessary to do was to divide the land already prepared and the additional acreage to be prepared in the spring into two portions, one area to be seeded to wheat and the other to oats, with some provision for a small plot for vegetables for household use. In those days there were one or two standard varieties of wheat and oats and all the farmer had to plan in advance was which of these he would seed, and when the spring came to go ahead and seed it. Having done this, his chances of reaping a fair crop yielding him a reasonable return for his labor were pretty good.

But those days are gone and probably gone forever. Down the corridor of the past two decades, the problem of what to raise and how much of it has become more complex with each succeeding year, and to-day the question bristles with so many complications and ramifications as to require the wisdom of a Solomon and the acumen of the proverbial Philadelphia lawyer, plus the insight of a skilful prognosticator if a reasonably satisfactory answer is to be the outcome.

If the farm operator in the prairie provinces wants to eliminate the gamble from his coming season's activities, he must not only be an experienced tiller of the soil and husbandman, but he also needs to be a student, a scientist, an economist and a meteorological expert. In other words he must achieve the unattainable.

When preparing his plans for the year's work the farmer not only has to take into consideration the condition of his land, the state of its suitability and preparedness for various types of crops, the probable availability of the kind of seed he would like to sow, the nature and extent of the hazard to which various crops and varieties may be subjected to deterioration and loss by insect pests and diseases, the probable effect of prospective weather conditions on those crops, the availability of nutriment in the soil required by different types of crops, the probable demand for the resultant yield in the local and world markets but many other factors which, for lack of space, must be dismissed in the auctioneer's phrase "too numerous to mention."

Many of these questions the farmer, because of his own circumstances and local conditions must decide for himself with very little assistance from outside sources, but fortunately there is aid available for him in his efforts to weigh probabilities and prospects of the effect of market trends, market conditions, national policies and to some extent even of international situations and relations on his intended acitivities, but even the information available on these factors can only be a guide, subject as they are and more particularly in recent years, to great and rapid fluxes.

One of the most valuable of these guides, entitled "The Agricultural Situation and Outlook, 1936" has just been issued by the Dominion Department of Agriculture with the co-operation of the Department of Trade and Commerce. The information it contains is compiled by the sub-committee on the agricultural outlook of the National Advisory Committee on Agricultural Services.

The government pamphlet contains a careful and concise survey of agricultural conditions as they existed in Canada in 1935, together with industrial conditions as they affected agriculture, beneficially and adversely, and the prospective position of agriculture for 1936, including some specific conclusions which cannot fail to be of material aid to every farmer who reads it.

As the foreword to this 52-page bulletin says: "This annual review of the position of Canadian agriculture contains basic information which will assist farmers in planning their business operations in 1936. It is, of course, impossible to take into consideration drastic changes in international affairs which might develop before the close of the year. The report, however, presents an analysis of the factors most likely to affect farm income in the coming year."

A particularly valuable feature of the report is the summarized conclusions published by the sub-committee with respect to each of the important cereal grains and several divisions of live stock, together with the reasons which lead up to these conclusions.

One who reads the bulletin cannot fail to be impressed with the fact that, generally speaking, the position of agriculture has shown improvement in the past year and that the factors in support of further improvement in 1936 are material, but it should be pointed out that the farmer who is carefully and intelligently studying the situation is the farmer who is in the best position to take advantage of this prospective continuing upward trend.

The pamphlet should be in the hands of every farmer in the prairie provinces and is worthy of study by all who are interested in the welfare of agriculture in the west and that means every citizen of the three provinces."

ECONOMIC LITERATURE

MENZIES-KITCHIN, A. W. Land Settlement. A report prepared for the Carnegie United Kingdom Trustees—Farm Economics Branch, School of Agriculture, Cambridge University.

This rather exhaustive report has been prompted by a desire to alleviate the conditions of the unemployed in Great Britain and is so embracing as to give consideration to the many general and economic factors involved. The author recognizes that to force people back to the land merely to provide employment will necessitate a return to more primitive methods of agriculture and a reversal of the normal trend of agricultural development. He treats of production and technical progress, of population change, supply and demand, wage rates, international comparisons of consumption and of recent efforts to regulate production through marketing boards. The writer also discusses the agricultural population and employment in various countries, the value and character of the products produced, the size of holdings, and the recent changes in the size of holdings, and points out the necessity of co-operation in the operation of certain sizes of holdings. Land settlement in various European countries is reviewed and the enterprises which appear logical for small holdings are analysed. The cost of establishment of settlers and a discussion of probable income is set forth along with the probable effects of land settlement on those already established in agriculture.

Commenting on the 20–50 acre farm, the writer states that in England and on the Continent the small mixed arable holding has a marked resistance to low agricultural prices. Experience shows that the settlement should be established on a colony basis in a district away from urban influence and dependent on an internal export market. Studies during 1932 in the Eastern counties of England reveal that 52 of the more profitable of such holdings averaging about 37 acres with 23 acres arable were capitalized at £460 per holding with 36% investment in crops and tenant right, 44% in live stock, and 20% in equipment machinery. The gross income was £418 per holding and gross expenditure £350 leaving £68 for farm income. The average family income was close to £146 per holding. After deducting family labour and interest on capital at 5% the small holder received on the average £95 for his own labour compared with the income of an employed miner or farm worker of 40s. per week.

From the study the author concludes that under present conditions land settlement offers little hope of creating additional employment on equal living standards. Increased agricultural production would lead to reduced imports, a reduction of exports and a decline of industrial employment. Effective demand is essential and must be generated by reduced cost or increased purchasing power.

The writer suggests that the 3–5 acre settlement is open to serious attack on account of the necessity of the settler leaning heavily on certain intensive crops which when prices fluctuate downwards leaves the producer with few alternative enterprises and probable failure. The pig, poultry and egg enterprises on the 3–5 acre farm are dependent on world feed prices which change with little reference to product prices. Luxury type vegetables he states are over-produced in Great Britain, thus reducing the possibilities with this enterprise. The writer commends the settlement that has been taking place under the direction of county councils which has been on a conservative basis, and settlement above that volume can only be condoned on a social or political basis. If the 3–5 acre settlement is to be fostered it must be safeguarded by a plan whereby buying and selling are done co-operatively. The 30–50 acre farm is more likely to be a satisfactory unit of settlement because of the greater freedom of the farm operator to change enterprises as farm produce prices fluctuate.

The general conclusion of the study is that a large scale policy of land settlement in Great Britain cannot be justified on economic grounds and can have little effect in solving the unemployment problem. If settlement is undertaken for social or political reasons, it will require support either by dearer food prices or direct subsidies.